TriSoft CP/M-68K

TRS-80 User's

Guide

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1.0 Introduction

Welcome to CP/M-68K® for the Tandy TRS-80® Model-16 and enhanced Model-II or Model-12. Combined with the existing CP/M for the Z80 processor (which we shall generically refer to as CP/M-80) your computer now has access to a software base second to none.

Documentation for CP/M-68K consists of five manuals. Four of these are from Digital Research, the creators of CP/M-68K. These manuals discuss the use and operation of the system, as well as an introduction to some of the internals of CP/M-68K. All of this information is relevant to ANY CP/M-68K installation, regardless of what company manufactured the computer or who performed the software customization. This gives an indication of one of the most important features of CP/M-68K, its transportability. Software you are now developing on the Tandy computer can be moved to any other CP/M-68K based system, usually without modification.

The other CP/M-68K manual (this one) is from TriSoft and discusses those things specific to the installation and use of TriSoft CP/M-68K on your Tandy computer. Much of this information involves descriptions of the internal hardware of the Tandy computer, and how the two CP/M systems (CP/M-68K and CP/M-80) interact. If you wish to skip this and go straight to the section on installation, you may do so without difficulty. But let us suggest that you at least give the other sections a quick 'look through'. The information they contain will help you better understand the computer you are going to be spending so much time with in the coming months, and will be worth the short time it takes to read.

CP/M is a trademark of Digital Research
TRS-80 is a trademark of Tandy/Radio Shack

Introduction

Many purchasers of CP/M-68K are already running CP/M on the Z80 processor in their computer. However, those who are also purchasing a Z80® version of CP/M from TriSoft will find enclosed an additional box. This is your 'other CP/M'. In it you will find an additional diskette and another set of manuals. Please set aside the CP/M-68K material for now. You will first need to install the Z80 CP/M system as described in the manual P&T CP/M 2 for the TRS-80 Model-II User's Manual. If you have ordered CP/M-80 from another vendor, but have not yet installed it, do so now. You MUST have a running version of CP/M-80 before beginning installation of CP/M-68K.

Z80 is a trademark of Zilog

2.0 Hardware Description

Tandy corporation makes three systems which can utilize the MC68000® microprocessor and CP/M-68K. These are the TRS-80 Model-16 which comes with the MC68000 as standard equipment, and the Model-II and Model-12 which can have the MC68000 processor added as an upgrade. With the upgrade all three computers become functionally virtually identical. For purposes of this discussion we shall treat them the same (unless noted otherwise), and refer to any of them simply as the TRS-80.

The TRS-80 is actually two computers in one. The first is built around the Z80 developed by Zilog. This is an 8-bit microprocessor, meaning that it handles data primarily in 8-bit chunks (a bit is a single unit of information which can take on only two values such as true/false or one/zero). It operates at a clock speed of 4 megahertz, or 4 million cycles per second, and for years has been the workhorse of the microprocessor industry. In addition to its internal registers (storage areas) it can directly reference 65,536 of these 8-bit chunks of information (called bytes), and up to 256 input/output (I/O) ports or devices.

Connected to the Z80 in the TRS-80 is either 32k bytes (32 times 1024) or 64k bytes of random access memory (RAM). It is in this memory that both the CP/M-80 operating system and your Z80 programs will reside during execution. Also connected to the Z80 are some number of I/O ports, usually about 12 depending on exactly what other options your particular system may have (i.e. clock, graphics card, hard disk). It is through these ports that the Z80 talks to the peripheral devices on your TRS-80, and hence communicates with the outside world.

$\overline{\text{MC68000}}$ is a trademark of Motorola

Hardware Description

The other processor in the TRS-80 is the Motorola MC68000. This is a relatively new chip which works with instructions and data from RAM 16 bits at a time, and internally is capable of processing data 32 bits at a time. For this reason you will often see the MC68000 listed as a 16/32-bit processor. Further the MC68000 in your TRS-80 runs at a much faster clock speed of 6.6 megahertz, and takes fewer clock cycles to perform similar operations. Also the MC68000 can directly reference up to 7 million 8-bit bytes of RAM (note: current physical limitations on the room inside the TRS-80 cabinet limit MC68000 RAM to 512k bytes or less). All of these factors serve to make the MC68000 a substantially more powerful processor, with many tasks running 6-10 times faster than on the Z80.

The minimum configuration which Tandy sells for the MC68000 is the processor and 128k bytes of RAM. Note that this RAM is completely separate from the 32k or 64k bytes of RAM used by the Z80 processor (see figure 2-1). Note also from the same figure that although the MC68000 can talk to an almost unlimited number of I/O devices (through a process called 'memory mapped I/O'), Tandy chose to not connect any external I/O devices directly to this processor.

Instead Tandy created in hardware a 'window' through which the Z80 processor may examine and, if desired, alter the contents of bytes of MC68000 memory. This gives the MC68000 an indirect method of accessing external I/O ports and devices, with the active cooperation of the Z80. The Z80 must be willing to 'look' into the MC68000's memory, see what is desired, and perform the operation itself. This is actually not as cumbersome as it might seem. In most applications it is actually beneficial because the Z80 now takes on some of the work which otherwise the MC68000 would have to perform itself, freeing the more powerful processor for those tasks to which it is better suited.

```
+-----------+   +----------+   +---+  +----------+   +-----+
|           |   |          |   |RAM|  |   Z80    |   | I/O |
| MC68000   |   |   RAM    |   |   |<->|          |<->|     |
|           |<->|          |   |for|  |processor |   |ports|
| processor |   |   for    |   |   | +>|          |   |     |
|           |   |          |   |Z80| | |          |   |     |
|           |   | MC68000  |   |   | | +----------+   +-----+
|           |   |          |   +---+ |
|           |   |          |   |     |
|           |   |          |<----------+
+-----------+   +----------+
```
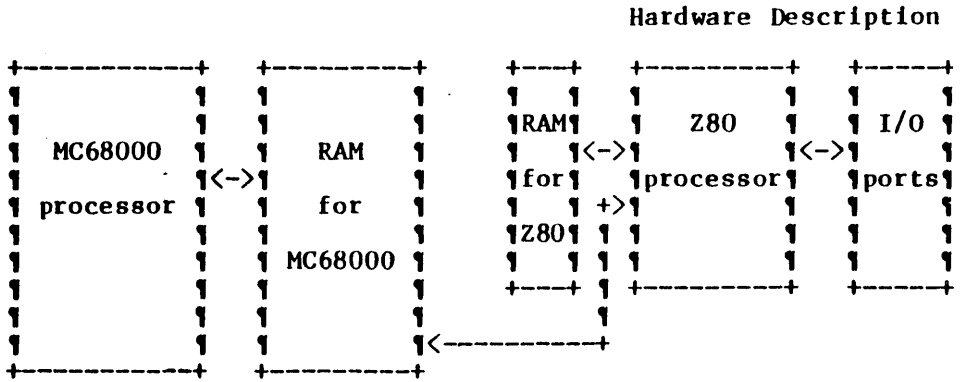
figure 2-1
TRS-80 Internal Structure

3.0 Operating System Description

Since both CP/M-80 and CP/M-68K are developed by Digital Research, and since both systems are intended to perform similar tasks and to respond to the user in ways that are as identical as is practical, it is not surprising that the internal layout of the two systems is also quite similar. Each system consists of three parts, the CCP, the BDOS, and the BIOS.

3.1 CCP

The CCP is the Console Command Processor, a program which is responsible for interpreting the commands which you type and causing action to be taken on those commands. The CCP is the 'user interface' in that it is this interaction with the CCP which most people think of as the operating system. Further, it is the quality of this user interface which people usually talk of when discussing how easy or difficult the system is to use, and whether or not it is 'user friendly'.

The CCP for both CP/M-80 and CP/M-68K is quite straightforward and easy to use. The commands are short, which makes for speed when typing, yet mnemonic enough to be easy to remember. For instance, to type a file to the console the command is simply TYPE and the name of the file. To display the directory of files in a particular user area the command is simply DIR.

A much more detailed description of the CCP is given in the 'Introduction to CP/M Features and Facilities' manual with CP/M-80, or the 'CP/M-68K Operating System User's Guide' with CP/M-68K. There you will find descriptions of each of the CCP commands, as well as descriptions of the format for file and device names. If you are already familiar with CP/M-80 then only a quick look at the CP/M-68K CCP description will be needed to get you up and running.

Operating System Description

3.2 BDOS

The Basic Disk Operating System is the actual heart of
CP/M. It is the BDOS which keeps track of files, loads data
and programs, and issues reads and writes to logical devices
throughout the computer system. It is the BDOS which deter-
mines to a very large degree the efficiency with which the
computer will operate. Further, the BDOS is the primary
interface between the actual computer hardware and the user
program. If the BDOS is logically designed and well thought
out, programs will be easy to write and debug. If it is
not, then the computer will be hard to use indeed. Even
programs in languages in which much of the BDOS interface is
'hidden' (such as BASIC and FORTRAN) are not immune, but
will suffer unnecessary restrictions such as only allowing a
limited number of files to be open at any one time, or
simply taking up so much of the hardware resources such as
time and memory that there is not enough remaining for many
user programs to operate correctly.

The BDOS for both CP/M-80 and CP/M-68K is not fancy,
but it is again well designed and efficient. Each provides
the user program with a logical list of functions which may
be performed and a simple consistent way of passing data
between the program and that function. These functions
consist of such things as 'read a line from the console',
'write a line to the console',and 'open a file'. The BDOS
functions for CP/M-80 are an almost exact subset of those
for CP/M-68K making conversion of programs very simple.

3.3 BIOS

The Basic I/O System is the place at which the differ-
ences between computer hardware vendors becomes apparent
(say, between a Tandy TRS-80 Model-16 and a Motorola
ExorMac, both having MC68000 processor but of quite
different design). Both the CCP and the BDOS are written
and supplied by Digital Research, and both will be the same
on ANY machine running the same version of CP/M-68K, no
matter how different the two machines themselves may be.
The BIOS is supplied by the various manufacturers and soft-
ware houses (TriSoft in this case), and must be customized
to the particular hardware on which it is to run.

The BIOS then is the interpreter between the hardware

and the BDOS operating system. We said earlier that the BDOS issued commands to have operations such as reads and writes performed on 'logical' devices. A 'logical' device is a generic thing such as a printer. In actual practice, one system may have a Radio Shack Lineprinter IV, another may have an EPSON MX100, and another may have no printer at all. The BDOS, at the request of the user's program normally, may issue a command to have a character printed on the printer. But in the first two cases above the commands actually issued to the hardware will be different, one may be on the Centronics printer port, the other may be on a serial port, or each may require different handling of special character codes. Further, the operator of the system with no printer may want output destined for the 'printer' to be displayed on the console instead.

The BIOS is the software which contains the information necessary to do each of these different things. The BIOS must contain instructions necessary to operate each different peripheral device which is connected to the system, as well as knowing what ports and addresses each is assigned. In addition the BIOS must know about any internal hardware, such as clocks and interrupts, necessary to the operation of the computer. The BIOS may also perform certain operations to improve the speed and efficiency of the machine such as combining several disk reads or writes into a single bigger one, or making one disk drive look like several.

Some of these last improvements have generated a few unfortunate side effects. Of the current CP/M-80 implement- ations for the TRS-80 (Lifeboat, Pickles&Trout, and ATON), incompatibilities exist particularly in the areas of double density diskette formats and console screen handling. TriSoft CP/M-68K supports the TRS-80 in conjunction with all these implementations. Since all I/O is handled through the Z80 under the CP/M-80 BIOS, TriSoft CP/M-68K will automat- ically configure itself to the devices and formats now in use. That means if you are now using Lifeboat CP/M-2.2, for example, then all of the diskette formats which it supports would still be available to you. If you are using Pickles& Trout CP/M-2.2 which supports their Triswatch clock card, then that card is supported under CP/M-68K also.

Operating System Description

3.4 Memory Layout

     Both CP/M-80 and CP/M-68K are organized in memory in
similar fashions (see figure 3-1). At the top of memory is
the operating system consisting of the CCP, the BDOS, and
the BIOS. At the bottom of memory is a small communications
region, and everything in-between is the Transient Program
Area or TPA. The TPA is the region of memory where the user
program resides during execution, and should be as large as
practical.

     Two differences exist between the two systems. First,
right at the bottom of MC68000 memory is a 1024 byte area
which is the hardware exception table. This is a special
region which contains pointers to functions to be performed
whenever certain abnormal or unusual conditions occur. This
would include such things as a reference to a memory address
out of range, or a divide check. Or it could indicate a
deliberate request by a program for action by another
(called a TRAP in MC68000 parlance). In any event, the
closest Z80 equivalent is buried in the communication
region, and not given as a separate area.

     The second difference is that because the Z80 can only
reference a very limited amount of memory (64k bytes) the
CCP region (and in some cases the BDOS as well) can be used
by a user program as part of the TPA. This has the effect
of slowing down warm boot returns from the program to the
CCP (because it must be read back in from disk), but is
essential on machines with small memories and large pro-
grams. On the MC68000 side memory is much less a problem
and the time consumed in loading the CCP after each warm
boot is not worth the small amount of memory saved.

```
         MC68000                              Z80
+-----------------+              +---------------+  'high'
¶       BIOS      ¶              ¶     BIOS      ¶ · memory
+-----------------+              +---------------+
¶       BDOS      ¶              ¶     BDOS      ¶
+-----------------+              +---------------+
¶       CCP       ¶              ¶     CCP       ¶
+-----------------+              +---------------+
¶                 ¶              ¶               ¶
¶       TPA       ¶              ¶     TPA       ¶
¶                 ¶              ¶               ¶
+-----------------+              +---------------+
¶ communication ¶                ¶ communication¶
+-----------------+              +---------------+  address
¶    exception    ¶                                   0000
¶     vectors     ¶
+-----------------+  address
                     00000000
```
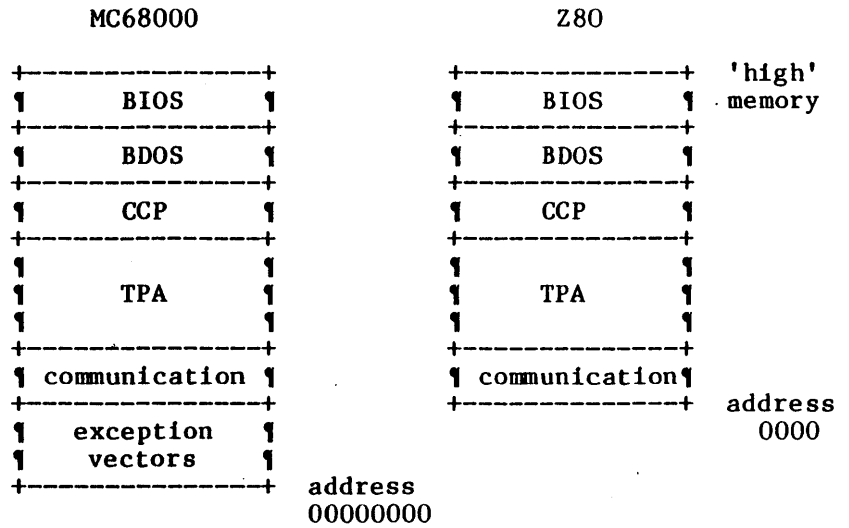
figure 3-1
CP/M Memory Layout

3-5

4.0 **Initial Installation**

TriSoft CP/M-68K comes on a set of six floppy diskettes, each in single density, single sided, CP/M standard format. Most of the files you will be using are located on diskette #6 labeled 'CP/M-68K Installation Diskette'. The rest of the diskettes may be set aside for now. Also, if you didn't do so earlier, it would not be a bad idea to make a backup copy of diskette #6 at this time. Even with the write protect notch uncovered (the small notch in the base of the diskette and off to one side) extra protection will seldom hurt.

To perform this initial installation of CP/M-68K you will need a TRS-80 (with MC68000 upgrade if necessary) running version 2.0 or later CP/M-80. It does not matter what vendor did the implementation of your CP/M-80. CP/M-68K will adapt itself as necessary. If you have not yet installed CP/M-80, you will need to do that first. Pile all of the CP/M-68K manuals and diskettes in a safe place and bring up CP/M-80 following the directions which came with that package.

Assuming that you have a running CP/M-80 system perform the following steps:

1. Boot your CP/M-80 system in the normal manner. The screen should display

    A>

2. At the keyboard type

    STAT

    and press the return key.

3. The screen should display

    A>STAT

    A: xxxk

where xxx is the number of bytes of storage remaining free on your CP/M-80 diskette. If this number is not greater than 241 you will need to use another diskette. Later in 'Running CP/M-68K' we will examine how to reduce the storage needs on your system diskette.

4. Insert the floppy diskette labeled "CP/M-68K Installation Diskette" in drive B. If you only have one drive but your system supports multiple logical drives then you should not insert the diskette until actually requested. Be sure that the write notch remains uncovered on the CP/M-68K master diskette.

5. On the keyboard enter

    SUBMIT B:MOVCPM68

6. This task will copy a number of files onto the CP/M-80 bootable diskette in the A drive. Although a number of utilities have the same name under both CP/M systems, the extensions are different (i.e. STAT.COM and STAT.68K) and no conflict should occur.

7. Assuming no errors occurred in the above step then that is all there is to it. You have installed CP/M-68K on a bootable system diskette. The next section will show you how to start CP/M-68K executing and how to switch back and forth between the two systems.

8. If somehow an error did occur in step 6. look up the error in your CP/M-80 manual. Did you have enough disk space (and directory entries) on the A drive? Is there an error (bad spot) on the diskette in the A drive? All TriSoft diskettes are top quality and are verified prior to shipping. If one of them has developed a problem (or been run over by a truck during delivery) contact us at once. We will get another one on its way to you immediately.

    If you still can't figure out the problem, give us a call. Remember, all you have used so far is CP/M-80. You have not yet actually run CP/M-68K.

5.0 **Running CP/M-68K**

5.1 Booting CP/M-68K

Bringing up CP/M-68K is really very simple. Boot your CP/M-80 system as usual, using the diskette created in section 4. The screen should show the familiar 'A>' prompt. Type:

        LDM68

and press the return key. [Told you it was simple, didn't we.] There should be a small delay while the CP/M-68K bootstrap loader is loaded into MC68000 memory. This step needs to be performed only once per cold start. That is, you will not need to type the LDM68 command again unless you press the RESET switch or power off your TRS-80. Your should now see the 'A>' prompt once again. Remember, you are still under CP/M-80. All you have done is load the CP/M-68K bootstrap.

        Both operating systems are now available to you. To switch to CP/M-68K simply type:

        M68

and press return. The first time you do this after loading the bootstrap there will be a small delay and the message should appear:

        TriSoft CP/M-68K, Ver x.x   C68-nnn-nnnnn   xxxk

where x.x is the current revision level and nnn-nnnnn is your unique serial number. This should be followed by the 'A>' prompt as always. But this time you are under CP/M-68K! Try it. You'll find the commands are virtually identical. Try 'TYPE'ing a small text file. Now just enter 'TYPE' and a return, without the filename. CP/M-68K will prompt you for the name of the file to TYPE.

Running CP/M-68K

When you want to switch back to CP/M-80 just enter (at the 'A>' prompt level):

                 Z80

and press return. You will see the ubiquitous 'A>', and you are under the CP/M-2.2 system.

From now on (or until you hit RESET) when you switch to CP/M-68K by typing 'M68' you should quickly see the 'A>' prompt and you are back under the CP/M-68K system. That's all there is to it. Remember, you do not need to use the LDM68 command again unless you press RESET or power off the TRS-80.

There is not much chance of problem in bringing up CP/M-68K. If you did have trouble check that the following files were located on your A: diskette or hard disk:

    CPM68.SYS   CPMLDR.SYS   LDM68.COM
    M68.COM   Z80.68K

What did the error message say (assuming you got one)? If you need help, please give us a call.

5.2 Minimizing Disk Space

The CP/M-68K system is quite frugal with disk space and normally runs quite well on the same diskette as CP/M-80. Still, you may wish to run CP/M-68K from a diskette which has large data files, or where you want to conserve free space for temporary files. So let us examine just exactly what files MUST be where, and when.

The only file with any specific requirements is the 'CPM68.SYS' file. This is the CP/M-68K operating system proper and absolutely MUST be on the A: drive when you first type 'M68'. However, once the system is booted (and you have received the TriSoft greeting message) it will not be needed again unless you use the 'LDM68' command. And this normally will not occur unless you RESET or power off the TRS-80.

Likewise, the file 'CPMLDR.SYS' is read from the default drive by 'LDM68' which is itself an ordinary CP/M-80 '.COM' type file. Both of these could be on some drive other than A: and simply set the default to that drive. And after the initial load they need not be present at all.

You will need 'M68.COM' and 'Z80.68K' whenever you switch between systems, but these can reside on other than the system diskette if necessary. They would then be executed by something like:

        A> B:M68

The rest of the files which were installed earlier (mostly '.68K' type extensions) are utility routines. These are the same type utilities you are familiar with; PIP, STAT, DDT, and such. None of them are needed on any particular disk and may be copied onto each diskette on an 'as needed' basis, or executed from a different diskette altogether.

A little experience with the system will show you which utilities you use heavily and which ones you may want to have only on certain diskettes. Also remember that there is some overlap in the operation of certain utilities. If you are really hurting for disk space, and don't mind switching between CP/M-80 and CP/M-68K a lot, you could delete one or the other set of files:

ED.COM	ED.68K
DUMP.COM	DUMP.68K
PIP.COM	PIP.68K
STAT.COM	STAT.68K

6.0 **Custom Installation**

6.1 Why Customize?

TriSoft CP/M-68K comes configured to run on a TRS-80 MC68000 system with 128k bytes of memory and virtually any brand of CP/M-80. Since Tandy includes a minimum of 128k bytes with every Model-16 or Model-II/12 upgrade you should have no trouble installing CP/M-68K on your system.

The custom installation procedure outlined in this section provides for two improvements over the 'generic' installation performed in sections 4 and 5. First, memory size. You will certainly wish to take advantage of any additional memory installed in your system. TriSoft CP/M-68K supports the full 1024k byte memory capability of the TRS-80, and can be expanded even further (up to 7 megabytes) if Tandy makes available hardware expansion cabinets and boards. You may also wish to configure CP/M-68K for somewhat less than the full memory. This allows for a buffer region which will remain untouched by the system, for whatever purposes you may desire.

Second, TriSoft CP/M-68K supports features of several of the more widely used CP/M-80 implementations, especially Pickles & Trout. This includes density re-select, clock set/reset, serial port read and serial port write. But it can only provide this support if it knows what vendor supplied your CP/M-80 system.

6.2 Customization Procedure

It is recommended that you read the entire procedure before beginning.

6.2.1 System Disk

The first step is to obtain a disk with a running version of CP/M-68K and CP/M-80. Sections 4 and 5 of this manual have shown you how to make this disk. You must have an executable version of CP/M-68K before attempting customization. The CP/M-80 PIP, SUBMIT, and STAT utilities should also be on this disk.

Custom Installation

    Approximately 200k bytes of free disk space will be
required for the customization procedure. Use the STAT
utility as you did in section 4 to verify that you have this
much space. If 200k is not available some unused files
should be erased or another disk should be used.

    At this point it is also recommended that a backup copy
of this system disk be made. The copy will be useful if an
error occurs during the procedure and the process must be
repeated.

6.2.2 SIZER

    Contained within the installation procedure is a
program called SIZER. This program modifies several files
used to create or execute CP/M-68K. These modifications
specify the desired memory size and the version of CP/M-80
to be supported.

    SIZER requires you to provide information on the
following:

        1. CP/M-80 vendor
        2. MC68000 memory size
        3. Memory management register values

SIZER first gives you an explanation of the type of inform-
ation needed, then requests your input.

6.2.2.1 CP/M-80 Vendor

    SIZER presents you with a menu of supported vendors of
TRS-80 CP/M-80 systems:

  Please enter the type of CP/M-2.x the Z80 is using (0-4):
        0 = Unknown
        1 = Pickles & Trout
        2 = Lifeboat
        3 = ATON
        4 = FMG

Each vendor is associated with a number. Respond to the question:

Your CP/M 2.x type (0-4):

by entering the number which matches your CP/M-80 vendor. If your vendor is not listed in the menu then simply enter '0' for unknown. The system will configure to use only those CP/M-80 capabilities specifically required by Digital Research specifications.

6.2.2.2 System Memory Size

TriSoft CP/M-68K may be configured for any memory size between 64k bytes and 1024k bytes. Remember that this refers only to the memory available to the MC68000, and that Z80 memory should not be counted. The amount of memory specified must be on a 16k byte boundary (i.e. 64, 80, 96,...,1024k). If the amount specified is not on a 16k boundary then it will be truncated to the next lower 16k boundary. For example, if you specify 92k as the memory size, SIZER will create an 80k system. The remaining 12k will not be available to the CP/M-68K system, but may be used by the user program.

SIZER prompts the user for the memory size with:

Please enter desired system size (64k-1024k):

You respond with the desired system size. SIZER will accept many different formats. Example:

                64K
                64
                64.0
                64.0K

would all produce a 64k byte system.

After accepting the memory size you will be notified that SIZER is:

***** Constructing an xxxK system *****

where xxx is the memory size used.

6.2.2.3 Memory Management Registers

The TRS-80 contains two sets of memory management registers. The Tandy document "Radio Shack Service Manual, TRS-16", Catalog number 26-60001/2 gives a description of these registers and how they are used. CP/M-68K does not require memory management. TriSoft CP/M-68K version 1.1 supports TRS-80 memory management in that it provides detection of buss errors and memory accesses out of the specified memory range.

Virtually all users will wish to take the default values provided by TriSoft CP/M-68K as best for the memory management registers. However, you may override this default and enter your own 16-bit hexadecimal value if your special application requires it. SIZER will prompt with the message:

            Please enter value for memory region 1
                  Type <ENTER> for default value :

and

            Please enter value for memory region 2
                  Type <ENTER> for default value :

Any desired value other than the default should be entered as a hexadecimal number (i.e. 1F00, AD00, etc.).

6.2.3 Execution of the Customization Procedure

Before proceeding, please examine the following check-list:

1. Make sure that the system disk is properly backed up. Once the customization process has begun the CP/M-68K system on this disk will be altered. Further, a running CP/M-68K system is required to perform the procedure. If a mistake is made and the only copy of the running system is destroyed you will have to go back to sections 4 and 5 to recover.

2. Always place the system disk in the A: drive to begin the customization process.

3. Make sure sufficient disk space is available on the system disk, around 200k bytes free.

4. Never create a system for more memory than your computer contains.

Now place the system disk in the A: drive. Next place the TriSoft supplied diskette #5 in the B: drive. If you only have one drive, but your system supports multiple logical drives, then do not insert the diskette in the logical drive B: until actually requested by the system. Be sure that the write notch remains uncovered on the TriSoft diskette throughout this and all installation procedures.

The following sequence is an annotated example of the installation procedure. To begin the customization program the user first boots CP/M-80 from the system disk in the A: drive. Then at the A> prompt enter:

A> SUBMIT B:INSTLCP6

As the submit file commands are executed they are displayed on the console:

A> PIP A:=B:SIZER.COM[V]

A> PIP A:=B:BIOSEQU.O[V]

A> PIP A:=B:BIOS.O[V]

A> PIP A:=B:CPMLIB[V]

A> SIZER

(At this point the user will be prompted with a series of questions. These questions and appropriate responses are covered in section 6.2.2 of this chapter on the SIZER program.)

A> LDM68

A> ERA SIZER.COM

```
A> ERA CPMLDR.SYS

A> REN CPMLDR.SYS=CPMLDR.NEW

A> M68                    .

    CP/M-68K(tm)  Version x.x
    Copyright (c) 1982 Digital Research, Inc.
    TriSoft CP/M-68K, Ver x.x  C68-nnn-nnnnn   xxxk

A>
```

Although CP/M-68K is now running, it is still the original 'generic' version. To complete the custom installation you must now type:

```
A> INSTAL68
```

The console will display:

```
A> LO68 -R -UCPM -O CPM.REL CPMLIB BIOSEQU.O BIOS.O

A> RELOC -Byyyyy CPM.REL CPM68.SYS

A> ERA INSTAL68.SUB

A> Z80

A> LDM68

A> ERA M68.COM

A> REN M68.COM=M68.NEW

A> ERA CPMLIB

A> M68
    CP/M-68K(tm) Version x.x
    Copyright (C) 1982 Digital Research, Inc.

    TriSoft CP/M-68K, Ver x.x  C68-nnn-nnnnn    xxxk

A>
```

You now have a CP/M-68K operating system that is fully customized to the memory and CP/M-80 vendor specified. Note that the customized files are:

CPM68.SYS   CPMLDR.SYS   M68.COM

You may copy these files to any other CP/M-68K system diskettes you are using. You will not need to go through the customization procedure again unless you change memory size or wish to customize the system for a different CP/M-80 vendor. One further note, if you are using the AS68 assembler remember that the Digital Research manual specifies that the assembler must be re-initialized any time you alter memory size.

7.0 **Special Features**

TriSoft CP/M-68K is compatible with all major TRS-80 CP/M-80 implementations. In addition it supports a number of features peculiar to the Pickles&Trout CP/M-80 implementation. TriSoft CP/M-68K also has several unique BIOS functions which can be invoked from the MC68000 user program to enhance operations specific to the TRS-80 dual processor environment.

7.1 General

Digital Research defines 22 BIOS calls for CP/M-68K, numbered 0 through 22 (there is no function number 17). Your CP/M-68K manuals titled "CP/M-68K Programmer's Guide" and "CP/M-68K System Guide" will show you how to post BIOS calls, either directly or through the BDOS. Although the latter introduces a slight increase in overhead it is the recommended method.

With either method the eventual result is a TRAP #3 to BIOS with:

```
                        +--------------+
    D0.W                ¶  function # ¶
              +------------------------+
    D1.L   ¶        parameter 1        ¶
              +------------------------+
    D2.L   ¶        parameter 2        ¶
              +------------------------+
```

where the actual function number is contained in the lower (LSB) byte of D0.W. To prevent conflict between any future DRI functions which may be added and the TriSoft additional functions, all TriSoft functions have the upper bit of this lower byte set. In other words, all TriSoft functions start at 80 hex.

7.2 Detail of TriSoft Special Functions

Special Features

7.2.1   Function 80 -- NOP

         Parameters: none

         This function is used primarily to synchronize the
         two processors. Although it is available to the
         user, it performs little useful function at the
         user level.

7.2.2   Function 81 -- EXIT

         Parameters: none

         This function is used to exit CP/M-68K and return
         to CP/M-80 with a warm boot. Execution of the
         MC68000 user program issuing this function will be
         suspended until the user re-enters the 'M68'
         command to return to CP/M-68K. The MC68000 program
         will resume execution following the BIOS call.

         The EXIT function may be invoked by a MC68000
         program to force the user back to CP/M-80 without
         giving up control under CP/M-68K.

7.2.3   Function 82 -- Pickles&Trout Call

Parameters:
$$D1.L == BC \P DE$$
$$D2.L == Ax \P HL$$

Pickles&Trout, in there more recent implemen-
tations of CP/M-2.2, has defined a number of calls
for special functions of their own. These are
normally accessed by loading the registers with
various values, including a function number in the
B register, and performing a CALL to address 0040h
(or address 0043h from a high level language).
The functions supported by these calls include
control of the CRT screen, definition of the
Centronics and serial ports, Centronics and serial
port I/O, and access to their TRISWATCH chronolog
clock card.

TriSoft provides access to these P&T functions via
special function 82. The proper values for the
various Z80 registers are given in the Pickles&
Trout CP/M installation manual. Remember that
this function is meaningful only if you are
running an appropriate version of Pickles&Trout
CP/M-2.2.

The file TIME.S is supplied by TriSoft as an
example of the use of function 82. It accesses
the system clock maintained under P&T CP/M-2.2 and
returns the time in the same format as TIME.ASM
provided by Pickles&Trout.

Special Features

7.2.4 Function 83 -- INP (input value from a port)

        Parameters:
                +---------+---------+---------+---------+
        Dl.L == ¶   xxx   ¶   port ¶   xxx   ¶ rtn val ¶
                +---------+---------+---------+---------+

        This function is used to read an 8-bit value from
        a Z80 I/O port. The number and meaning of these
        ports is given in the Radio Shack Model-II and
        Model-16 Service Manuals.

        Upon entry the second byte of Dl.L contains the
        port number to be read and has a range from 00 to
        FF hex. Upon return the value read from the port
        will be in Dl.B, the low order byte of Dl.L.

7.2.5 Function 84 -- OUT (output value to a port)

        Parameters:
                +---------+---------+---------+---------+
        Dl.L == ¶   xxx   ¶   port ¶   xxx   ¶ out val ¶
                +---------+---------+---------+---------+

        This function is the complement of INP in that it
        outputs an 8-bit value to a designated Z80 I/O
        port. Upon entry the second byte of Dl.L contains
        a port number between 00 and FF hex. The lower
        byte Dl.B contains the 8-bit value to be output.

7.2.6   Function 85 -- MEMRD   (read byte of Z80 memory)

Parameters:
```
          +---------+---------+---------+---------+
D1.L  ==  ¶    Z80 address    ¶   xxx   ¶   byte  ¶
          +---------+---------+---------+---------+
```

This function is similar to INP, except the contents of a byte of Z80 memory is returned. Upon entry the upper word of D1.L contains a Z80 16-bit address. Upon return the lower byte D1.B contains the 8-bit value which was read.

7.2.7   Function 86 -- MEMWR   (write byte of Z80 memory)

Parameters:
```
          +---------+---------+---------+---------+
D1.L  ==  ¶    Z80 address    ¶   xxx   ¶   byte  ¶
          +---------+---------+---------+---------+
```

This function is the complement of MEMRD in that it writes an 8-bit value into a byte of Z80 memory. Upon entry the value is contained in D1.B and the 16-bit Z80 address is contained in the upper word of D1.L.

Special Features

7.2.8   Function 87 -- PATCH   (TriSoft Reserved Patch Call)

Parameters:
```
              +---------+---------+---------+---------+
D1.L  ==   ¶            - as needed -               ¶
              +---------+---------+---------+---------+
```

The PATCH function provides a means of connecting an additional M68 routine to a CP/M-68K BIOS special call. In general, this function is not needed by the CP/M-68K user.

7.2.9   Function 88 -- REXIT   (release 68000 and EXIT)

Parameters:

D1.L ==   none

The Release and EXIT function allows CP/M-68K to continue execution, while returning control of the system resources to the CP/M-2.2 system. This is primarily of use to those persons with LARGE COMPUTE BOUND jobs which go for substantial periods of time without performing any I/O (such as matrix inversion or in-memory FFT computations).

Certain precautions MUST be followed when using this function. First, the 68000 task issuing the REXIT function should re-establish communication by issuing a NOP special function (code 81 hex). Second, if a diskette is to be altered while in CP/M-2.2 (such as by editing a file), then the CP/M-68K task must have closed all open files prior to issuing the REXIT, then after execution of the NOP the CP/M-68K task should issue a RESET DISK SYSTEM function to the BDOS (code 0D hex).

7.2.10   Function 89 -- SCON   (set configuration table)

Parameters:

```
              +---------+---------+---------+---------+
Dl.L  ==    ¶      subfield      ¶   config. element  ¶
              +---------+---------+---------+---------+
```

Several TriSoft CP/M-68K BIOS functions may be altered to make the system more closely the needs of the user. The state of these functions is maintained in a 'configuration table' kept within the CP/M-68K BIOS. The functions within this table may be temporarily (i.e. until the next cold start) changed with the SCON function.

In the parameter Dl.L the configuration element represents the function to be altered. The subfield contains the new value for this function (if needed). Current legal entries are:

```
       element   subfield   meaning
       -------   --------   ----------------------------
          0         x       NOP - no operation
CON:      1         0       TABS - pass tabs unchanged
CON:      1         1       NOTABS - expand tabs to blanks
LST:      2         0       LIST - pass all to LST:
LST:      2         1       FTN - col. 1 is carriage cntl
```

8.0 **Quirks, Foibles, and Miscellaneous**

CP/M-68K does an excellent job of maintaining compati-
bility with CP/M-80, while providing a number of new
features and capabilities. In almost every aspect these new
features are a superset of CP/M-80. That is, system
commands which work under CP/M-80 should continue to work
under CP/M-68K. A few discrepancies and changes should be
noted however.

8.1   Keyboard Typeahead

The ability to enter new commands and data from the
keyboard before the program or system is ready to accept
them is called typeahead. Digital Research does not support
this capability in any of their earlier CP/M products. In
spite of this, several companies (including Pickles&Trout)
were able to create a pseudo-typeahead with special code in
their CP/M-80 BIOS. Although it did not always work cor-
rectly (a number of programs 'ate' the first character which
was typed ahead), it still was a useful feature.

TriSoft CP/M-68K supports typeahead in version 1.2 and
beyond. This means you do may enter both commands and data
from the CON: device without waiting for the task or system
to be ready. This can result in a substantial improvement
in effective system performance, since your typing speed,
and the system speed, can now 'average out' each other.

Two small caveats should be noted with regard to
typeahead. First, some tasks or CP/M-2.2 BIOS
implementations which lock out interrupts may cause loss of
input characters during heavy CPU computation. And second,
a very few programs exist which 'eat' all characters typed
while they are running. These programs were designed before
typeahead became popular, and represent a deficiency in the
program rather than the system.

Quirks, Foibles, and Miscellaneous

8.2 Diskette Density Select

When most CP/M-80 implementations were done for the
Tandy computers Digital Research had not defined the infor-
mation which told the BIOS that a diskette was or was not
logged in. This information is necessary for the BIOS to
know when to redetermine the density and format of the
diskette. Every implementation we are familiar with found a
way around this problem and developed some method of their
own to know which diskettes has or has not been logged in.
Unfortunately every single company picked a different
method.

TriSoft CP/M-68K is compatible with all major CP/M-80
implementations for the Tandy computers. Special code has
been added to the TriSoft CP/M-68K BIOS to use these
'special methods' with each CP/M-80 implementation. This
should work well with Pickles&Trout and Lifeboat. TriSoft
also conforms to the now defined standard for notification
of need for density/format selection, and should work
correctly with all future CP/M-80 BIOS developments.

What does it mean if your CP/M-80 implementation is not
compatible with the Digital Research standard and not one of
those for which special code has been added to compensate
for that fact? Not a big deal, really. It simply means
that if you are under CP/M-68K and want to swap a diskette
for another of a different density or format you will need
to exit and re-enter CP/M-68K. Simply type 'Z80' and once
you get the A> prompt type 'M68'. The next time you
reference a drive it will be checked for proper density and
format.

Remember, you need do this only if you replace a disk-
ette with another of a different density or format. Simply
swapping diskettes of the same density and format, which is
the normal case, causes no problem. And if your CP/M-80 is
from Lifeboat or Pickles&Trout then you will not see the
problem anyway.

8.3 Direct Screen Updating

A few CP/M-80 programs which are heavily display
oriented achieve extra speed by mapping the display memory
directly into Z80 memory address space. Wordstar is
probably the major package in use on the TRS-80 business

computers which performs this function.

Note from the hardware description and figure of section 2 that there is no direct connection between the MC68000 processor and the Z80 memory space. The result is that it is not possible for a program running under CP/M-68K on a TRS-80 to perform this same trick. Such programs will be able to use the screen, of course, but in the normal CP/M defined character mode.

While we expect MicroPro to make Wordstar available for the CP/M-68K system, we do not feel that any benefit would be realized on the TRS-80. Since many users are already using Wordstar under CP/M-80, we suggest they continue to do so. It is our opinion that the performance of Wordstar under CP/M-68K on a Tandy TRS-80 would not be significantly better than under CP/M-80 on the same system.

8.4 FORMAT

As stated before, TriSoft CP/M-68K configures itself to the CP/M-80 you are presently running and supports the same formats which your CP/M-80 supports. Digital Research lists for CP/M-68K a program called FORMAT. As explained in the Digital Research CP/M-68K User's Guide this program is included for example only (unless you happen to be running a Motorola ExorMAC). To format diskettes on your TRS-80 you should use the formatting programs supplied by your CP/M-80 vendor.

8.5 COPY

Digital Research has included a program called COPY with CP/M-68K. This is a 'track-to-track' diskette copy program which makes an exact duplicate of all or part of a source diskette. To do this the COPY program works through the BIOS of CP/M-68K, and whatever capabilities and restrictions are imposed by CP/M-80. This causes a couple of minor problems.

The first problem involves copying the BOOT tracks (tracks 0 and 1 of most floppy diskettes). Many vendors, including Pickles&Trout, protect either implicitly or explicitly the boot tracks of their system diskettes to prevent piracy. This prevents COPY from copying the boot

tracks of double density diskettes on such systems. It can still be used to copy the files of such diskettes using the FILES option.

The second problem involves those CP/M-80 implementations which do not permit density reselection from a running program. If you should have such a CP/M-80 then you will not be able to use COPY on a diskette with a different density/format from that currently logged in on a given drive. This is usually only a problem with copying single density diskettes from the A: drive. For this situation the more traditional command

        PIP B:=A:*.*[RGi]

is preferable. The 'Gi' option selects the 'i'th user number and is necessary only if more than one user directory is maintained on the disk.

Note that the above problem does not exist for ATON, Lifeboat or Pickles&Trout CP/M-80.

8.6   Cold Boot AUTO-EXECUTE

The current version of TriSoft CP/M-68K does not support the auto-execute capability. This does not effect any such capability which may be supported by your CP/M-80 implementation.

9.0 **Problems and Updates**

The TriSoft BIOS for CP/M-68K underwent over four months of testing before it was considered ready for release. The CP/M-68K system itself has also undergone extensive testing by TriSoft and others. Every effort has been made to provide you with a fast, efficient, and reliable software tool.

9.1 Updates

There are two reasons for updates, to fix something that doesn't work right, and to make something that does work perform even better. TriSoft will support our customers with both kinds of updates.

Updates and fixes will come from two sources, TriSoft and Digital Research. Digital Research will send updates to TriSoft where they will be distributed to each registered TriSoft CP/M-68K user. It is important that we receive your registration card. And if you move, let us know. This the only way we have to get information to you.

Where possible, fixes to problems will be distributed as detailed patch instructions. These can be mailed out quickly and are the fastest way of getting information to you. Occasionally a fix may be of such an extensive nature that it requires a diskette for distribution. In this case update diskettes will be make available at cost, hopefully just a few dollars. If the problem is of such a nature that it seriously impairs the usability of TriSoft CP/M-68K then the update diskettes will be available at no cost. We support what we sell.

9.2 New Versions

As with all active growing systems upgrade versions will be issued periodically. These will originate both with TriSoft and with Digital Research, and will represent significant improvement in performance and/or capabilities over previous versions. It is the policy of Digital Research to make these new versions available to TriSoft for a nominal fee. TriSoft will offer these upgrades to

existing customers at the most reasonable rate possible
(remember, those diskettes and manuals cost money). We will
always strive to make available the most current revision
levels as soon as they become available to us.

Digital Research intends to also issue new types of
operating systems for the MC68000 processor. These will
include a concurrent capability system (one user performing
multiple tasks) and a multi-user capability system.
Although it is not the policy of Digital Research to offer
these systems as upgrades, TriSoft plans to provide
discounts to registered CP/M-68K customers.

9.3 Problem Reports

TriSoft exhaustively tests every piece of software
before it is shipped. If you should have a problem we want
to know about it (and I am sure you will want to tell us).

Questions or simple 'How do I ... ?' type problems can
normally be handled by phone. Suspected bugs or complicated
problems are best handled by mail. The form in Appendix B
gives you an idea of the type of information we will need.
It is hard to send to much information. The most critical
step towards solving a problem is our ability to reproduce
it. Send us what we need to do that.

If you can't wait for the mail, try the phone. We will
do what we can. But the mail is still the best bet. A
diskette that shows the problem, plus a description of what
steps will cause it, will give us the best chance of getting
you a speedy solution.

We promise to investigate each problem report you send
us. If the problem involves TriSoft software we will fix it
if at all possible. If the problem is determined to reside
in Digital Research CP/M-68K code we will refer the problem
to them for a solution. And then we will keep after them
until we get that solution. But remember, both TriSoft and
Digital Research can only support you if you remember to
return the registration card. Do it.

Appendix A

Related Reading

The following books are available in computer stores, public libraries, and larger bookstores. They contain information which may be of interest to the user of CP/M-80 or CP/M-68K.

The CP/M Handbook, Rodney Zaks, Sybex 1980.

MC68000 16-Bit Microprocessor User's Manual, Motorola MC68000UM[AD3] 1982.

MC68000 Cross Macro Assembler Reference Manual, Motorola M68KXASM[D3] 1979.

68000 Assembly Language Programming, Gerry Kane, Doug Hawkins, Lance Leventhal, Osborne/McGraw-Hill 1981.

The C Programming Language, Brian W. Kernighan, Dennis M. Ritchie; Bell Labs, Prentis-Hall 1978.

also of interest...

"Two/Sixteen Magazine", Richard Young ed., Box 1216, Lancaster, PA 17603

Appendix B

Problem Report

Name _____   Date _____

Address _____   Product _____

_____   Version # _____

Phone   (   ) _____ — _____   Serial # _____

Machine description (Model, memory, disks, etc.) _____

_____

CP/M-80 vendor_____   Version # _____
==

Description of problem: (Be as specific as possible. Give
   command sequences, screen printout, anything which might
   be of   use. If you have a printer, try to get a copy
   of the screen   using the ©P command.   State what
   processor/program the   problem occurs in.)

_____

_____

_____

_____

_____

_____

_____

Enclosures (listings, printouts, diskettes): _____

_____

Anything else useful: _____

_____

Example

Appendix B

Problem Report

Name ___John Carter___   Date _10 Mar 8_

Address _1323 Wiring Street_   Product _CPM-68K_

___Delhi, Texas 75713___   Version # _1.1a_

Phone _(512) 555 - 9800_   Serial # _C.68-2021._

Machine description (Model, memory, disks, etc.) _Model-16_

128K, 2- Slim lines, Printer, Triswatch

CP/M-80 vendor _P + T_   Version # _2.2M_

===

Description of problem: (Be as specific as possible. Give
   command sequences, screen printout, anything which might
   be of   use. If you have a printer, try to get a copy
   of the screen   using the ©P command. State what
   processor/program the   problem occurs in.)

Cannot set Triswatch under CP/M -68K,

using BIOS call 82. Have attached

listing of program, Also sample

test case.

_____

_____

_____

Enclosures (listings, printouts, diskettes): _Printouts_

_____

Anything else useful: _Problem only occurs on_

even Numbered Tuespays!

Appendix C

FIND

Documentation on the FIND program from Digital Research may be found in the update supplied for their manual. However, it is worthwhile to discuss some of the possible 'non-obvious' uses for this program.

The FIND program is used to locate a string within a file or files. This is frequently useful when you have a large number of files of similar type (say, memos filed by date) and need to know quickly which one referenced a particular topic. You could, for instance, locate the one which discussed the Veeblefeester account by simply typing:

A> FIND Veeblefeester memo*.*

and FIND would return with the information that the string Veeblefeester occurred in file MEMOJUN83.DAT.

But the FIND utility can be used for many other things. Have trouble remembering telephone numbers? Just use the editor to create a file called PHONE.DAT, and enter:

```
Jones, P.Q.; 4122 North Street,   (512)444-1212
Smith, A.B.; 222 West 11th,       (512)999-5555
TriSoft;4102 Avenue G,            (512)453-2233
     (etc.)
```

and create the file PHONE.SUB which contains:

FIND $1 PHONE.DAT

Now anytime CP/M-68K is running at the command level just enter:

A> PHONE Smith

and get back the information:

Smith, A.B.; 222 West 11th,   (512)999-5555

Many types of simple 'database' functions can be set up this way using FIND and the automatic SUBMIT facility of CP/M-68K.

Appendix C

LOGIN

    With the slim-line drives which automatically power
down, and with a serial port connected to an auto-answer
modem, the TRS-80 is quite capable of remote unattended
operation. Simply insert your system diskette, boot the
system, and type:

        A> STAT CON:=TTY:

and you are ready to go. Unfortunately, this leaves your
diskette, and all the files on it, at the mercy of anyone
who happens to dial the number. LOGIN provides a small, but
frequently adequate, amount of security for unattended
systems.

    The prospective user who dials in is answered by the
modem and gets the system's attention by typing a carriage
return (the <enter> key). The system responds with a
greeting message of your choice and asks the user for a
'Name'. After suppling a name, the user is asked for a
'Password' which is NOT echoed back to the user for security
reasons. When the user supplies a password the system
checks BOTH the name and password against that established
by the system owner. If they match, the user is allowed
access.

    If the name and password supplied by the user do not
match then the user is given two more chances to enter the
correct information. If the user fails to do so within
three tries then the system 'hangs' for a preset period of
time (currently 30 seconds) before allowing more tries.
This prevents a 'cracker' with another computer from simply
trying thousands of combinations per hour.

    Setting up LOGIN is simple, but involves several steps.
The first is establishing the 'LOGIN.DAT' file. This can be
created with the ED editor, and consists of three lines of
text. The first is the greeting message, the second line is
the 'Name', and the third is the 'Password'. Each of these
can be up to 80 characters long, and upper/lower case is
checked. If no LOGIN.DAT file is provided the default is:

```
CP/M-80 :: CP/M-68K System          (greeting)
ANONYMOUS                           (name)
GUEST                               (password)
```

The second file which must be created is the submit file to
a) set the CON: device to the serial port, and b) bring up
the LOGIN task. The file to do this should be called
LOGIN.SUB, and consists of:

```
STAT CON:=TTY:
LOGIN
```

It is suggested that the LOGIN.COM, LOGIN.DAT, and LOGIN.SUB
files be 'hidden' with the command:

```
A> STAT LOGIN.* $SYS
```

Caveats: There are several cautions which must be remem-
bered about the LOGIN program provided here. First, the
remote user MUST restart the LOGIN task before dis-
connecting. This is done by simply returning to CP/M-2.2
and typing 'LOGIN' at the command level. But if the user
does not do this, then the system will not be protected from
the next caller. Second, once a user has correctly given
the name and password he is in full control of the system.
This means he can change the LOGIN.DAT file. And third,
although a 'name' and 'password' is the protection used by
most timesharing systems, TriSoft can make no guarantees.
ANY protection that can be designed can be cracked!

Users interested in more elaborate security mechanisms
might wish to investigate the excellant public domain
program BYE which allows control of user directories and
controls access to (and execution of) programs on a flexible
owner-controlled basis. There are several extremely good
Remote CP/M (RCPM) and Community Bulletin Board (CBBS)
packages available for the TRS-80, both commercial and
public domain.

Appendix C

MEMTST68

Tandy does not provide a memory test for the 68000 memory boards in the TRS-80. Unfortunately, they also decided not to include parity detection. This means that memory problems can often go undetected, causing a good deal of frustration and lost work. TriSoft provides the utility MEMTST68 to aid in the early detection of 68000 memory problems. Note that this program runs under the Z80 CP/M-2.2 or CP/M-Plus system so as to make available the entire 68000 memory for testing.

To execute the MEMTST68 utility simply enter:

A> MEMTST68

The rest is basically self explainatory. MEMTST68 performs a number of tests. The first test checks for the amount of memory available to the 68000 processor and reports the amount to the user. An address line test is then performed to verify that all of that memory can be uniquely accessed without interference from other banks.

MEMTST68 then performs a number of data test on the available 68000 memory. These include various bit patterns, as well as test of the memory refresh circuitry. Any errors are reported, giving the address and faulty data values.

TriSoft cannot make any guarantees that MEMTST68 will catch all errors in 68000 memory (no test will). However, we suggest it be run whenever suspicious problems occur to help eliminate (or incriminate) the 68000 memory boards.

Appendix C

NEWDISK

CP/M-68K does not 'log out' diskettes every time a warm boot or ©C is performed. This has the advantage of greatly increasing the speed with which the A> prompt is returned. The only problem caused by this is that the system will some times attempt to access a diskette which has been removed from a drive.

NEWDISK notifies the system that a change has been made to the disk drive system. Either a diskette has been removed and not replaced, or the density or format of a replacement diskette has changed and no warm boot was performed. The result is that each diskette, when first accessed following the NEWDISK command, will be tested for density or format.

Remember, it is not necessary to issue the NEWDISK command unless you have replaced a logged in diskette in a particular drive with one of a different density or format and have not done a warm boot, or have accessed a diskette on a drive and no longer want the system to consider that drive as 'logged in'.

NEWDISK can be used with any CP/M-80 implementation to RESET the CP/M-68K disk drive status. However, NEWDISK can only cause density/format reselection with those CP/M-80 implementations which support density/format change from the user level. Should your CP/M-80 be one of the few which do not support this feature (see section 8.2) then you may achieve a similar result for all except the A: drive by entering the Z80 and M68 command sequences.

Appendix C

SD
SORTED DIRECTORY (68K)

The SD-68K program provides a means of displaying a directory of user files, sorted in alphabetic order. It is intended as a CP/M-68K counterpoint to the excellant public domain program SD written for CP/M-2.x by Bruce Ratoff (and modified by almost everyone, including myself). Although the two programs are not identical in terms of options and capabilities, SD-68K will accept the most commonly used options in a form consistent with SD.COM. Also, since the extensions are different for the two programs, both may coexist on a disk; one as SD.COM, and the other as SD.68K.

USE: SD.68K is invoked as

      A> SD [file-spec] [>outfile] [-optionlist]

where the items in brackets are all optional and position independent.

file-spec == standard CP/M file specification of the form

      d:name.typ

including * and ? wildcards.

>outfile == this option re-directs the output to a CP/M file where 'outfile' is the file-spec.

-optionlist == is a list of options controlling the output format from SD. These options may be either 'lumped' together, or separately with each preceeded by a '-' flag (ala UNIX). A '$' character may be used instead of the '-' for compatibility with CP/M-2.x SD.

Valid options are:

    -K == toggle display of file sized (default is to display size)

C-6

-S == toggle display of 'system' files
       (default is to not display
       'system' files)

-F == toggle display of file 'flags'
       (default is to not display flags).
       Flags are:

                    S == system file
                    R == read only
                    A == archived

Examples of valid SD commands:

   SD   == list all files on current
                                default disk and directory.

   SD *.*   == same as above.

   SD test.*   == list all files on current
                                default disk and directory
                                with 'test' as the file
                                name.

   SD -S -F ABC?DE.DAT >FILES.LIS ==
                                list all files on current
                                default disk and directory
                                with the file name 'ABC',
                                any letter, 'DE', and type
                                'DAT'. Output will be to
                                file 'FILES.LIS', flags
                                will be displayed, and
                                system files included.

   SD >FILES.LIS ABC?DE.DAT $FS   == same as above

Appendix C

Display formats are:

File names only == 6 names per line

File names and == 4 names per line
  either size or
  flags

File names and == 3 names per line
  both size and
  flags

Appendix C

SET

SET allows the TriSoft CP/M-68K user to alter some of the characteristics of the system. These commands remain in effect until canceled by a corresponding SET command, or until a new COLD boot. SET commands currently implemented are:

    A> SET CON: TABS   [enable tab expansion]

    A> SET CON: NOTABS   [disable tab expansion]

    A> SET LST: FTN   [enable FORTRAN style *
                               carriage control]

    A> SET LST: LIST   [disable carriage control]

*
Currently FORTRAN carriage control recognizes two control characters in column 1 of the output to the LST: device as having special meaning. They are:

    character   meaning
    ---------   ---
        1   Convert to Top-of-Form (0C hex)

        0   Suppress Linefeed at end of current line

Appendix C

SHOW

SHOW is a simple utility which provides a replacement for the CPM intrinsic command TYPE. Like TYPE, the syntax is:

A> SHOW fname

SHOW will first attempt to open the file 'fname'. If successful it will display the file onto the CON: device one screen at the time.

At the bottom of the screen SHOW will prompt:

— more —

and wait for input from the CON: device (normally the keyboard). The valid responses are:

<enter>   -- pressing the enter key will display the next line.

<space>   -- pressing the space bar will display the next page.

<break>   -- pressing the break key (or typing control-C) will return you to the 'A>' prompt.

TIME

Pickles&Trout provides a special set of system calls to access various hardware functions of the TRS-80. An example program called TIME.COM is provided by them to demonstrate the use of these special calls.

TriSoft CP/M-68K supports these special Pickles&Trout calls from the MC68000. The use of these calls is explained in section 7.2.3, function 82. An example of accessing the CP/M-80 calls from CP/M-68K is given in the source file TIME.S. It is not intended to be an optimum program to do this, merely a demonstration of how it can be done.

The executable file for this is named TIME.68K and may be invoked at the command level by entering:

A> TIME

The current system time will be displayed. Note that the system time defaults to the time since the last power-up or reset. It may be set to the current time-of-day by the Pickles&Trout CP/M-80 command SETTIME.

Remember that the TIME.68K program will work correctly only if you are running Pickles&Trout CP/M-2.2 on the Z80 side of your computer. Any other vendor implementation of CP/M-80 will return garbage for the system time.

Appendix C

VT52

VT52 is a rather simple terminal emulator for ATON, Pickles&Trout CP/M-2.2, or TANDY CP/M-Plus. Three versions are provided:

    o VT52ATON -- for the ATON CP/M-2.2 system

    o VT52PLUS -- for the TANDY CP/M-Plus system

    o VT52PNT -- for the Pickles&Trout CP/M-2.2 system

You may wish to rename the one which matches your CP/M-2.2 vendor to the task name 'VT52.COM'.

This program provides for asynchronous terminal communication over the serial-A (also called SIO-A) RS-232 port on your TRS-80. It provides a subset of the screen handling commands available on a Digital Equipment Corp. VT52 terminal. For those familiar with DEC mainframes, this means that such programs as PHONE and MONITOR will work. The screen editor EDT will also work, but is cumbersome because of the lack of a configurable keypad (the one on the TRS-80 does not generate unique codes).

Two control functions are provided. They are:

    o F1 -- exit back to CP/M-2.2

    o F2 -- (toggle) enables printing of information
            received from the host computer to the LST:
            device (printer). Output is buffered for
            slow printers.

No file transfer capability is included with this program. Users needing more sophisticated capability, including file transfer with error checking, should investigate the several well known commercial terminal programs available, as well as the two very popular public domain terminal programs, MODEM and KERMIT.

Appendix C

Z80

The utility Z80 provides a convenient means to switch from the TriSoft CP/M-68K system to the CP/M-2.2 system. At the CP/M-68K prompt simply type:

A> Z80

You will exit CP/M-68K and be presented by CP/M-2.2 with it's 'A>' system prompt.

Often, however, you may wish to return to CP/M-2.2 to execute only a single command and then return to CP/M-68K. Z80 provides a simple way to do this. Add the CP/M-2.2 command you want to execute to the end of the Z80 command. Example, suppose you are under CP/M-68K and wish to execute the CP/M-2.2 command 'FOOBAR FOO1 FOO2'. Then you would enter:

A> Z80 FOOBAR FOO1 FOO2

TriSoft CP/M-68K would suspend momentarily. CP/M-2.2 would execute the program FOOBAR with file specs FOO1 and FOO2, then you would be returned to CP/M-68K automatically.

One minor note of caution. The auto-return feature uses the SUBMIT capability of the CP/M-2.2 system. Since the normal submit routine provided by DRI does not allow 'add on' submit files the command:

A> Z80 SUBMIT FOOSUB

would switch to CP/M-2.2 and execute the command file FOOSUB, but would not return automatically to CP/M-68K. This will work, however, with any of the several fine public domain SUBMIT replacements (such as SuperSUB) available from most CP/M computer clubs.

Appendix D

NEWDISK

CP/M-68K does not 'log out' diskettes every time a warm boot or ©C is performed. This has the advantage of greatly increasing the speed with which the A> prompt is returned. The only problem caused by this is that the system will some times attempt to access a diskette which has been removed from a drive.

NEWDISK notifies the system that a change has been made to the disk drive system. Either a diskette has been removed and not replaced, or the density or format of a replacement diskette has changed and no warm boot was performed. The result is that each diskette, when first accessed following the NEWDISK command, will be tested for density or format.

Remember, it is not necessary to issue the NEWDISK command unless you have replaced a logged in diskette in a particular drive with one of a different density or format and have not done a warm boot, or have accessed a diskette on a drive and no longer want the system to consider that drive as 'logged in'.

NEWDISK can be used with any CP/M-80 implementation to RESET the CP/M-68K disk drive status. However, NEWDISK can only cause density/format reselection with those CP/M-80 imple-mentations which support density/format change from the user level. Should your CP/M-80 be one of the few which do not support this feature (see section 8.2) then you may achieve a similar result for all except the A: drive by entering the Z80 and M68 command sequences.

Appendix E

<u>Known BUGS</u>

The following errors are known to exist in version 1.2 of CP/M-68K. These problems exist in the code provided by Digital Research and they are aware of the problems. As soon as we have been notified of a fix it will be passed on to you (provided you returned the registration card).

1. The assembler (AS68.68K) generates files with bad relocation bits when a "movec" instruction follows an instruction which references a symbol. The following example:

    ```
                        move.l   d0,a
                        movec    vbr,d0
                        move.l   d0,b
                        .data
              a:        .dc.l    0
              b:        .dc.l    0
    ```

    illustrates the problem. A workaround is ·to place a ".dc.w $4e71" statement following the movec instruction. (4e71 is a NOP instruction). The assembler gives no error message, but neither linker (L068 or LINK68) will accept the file as input.

2. The assembler (AS68.68K) places a single-character ASCII constant in the high byte of a word operand. For example:

    ```
              move.w        #'U',d1
    ```

    loads d1 with the hex constant "5500". Of course, the argument could be made that you should use a byte instruction to do single character moves.

3. The assembler (AS68.68K) will evaluate a symbol of the form "$xyz" as a hex constant with value 0. If used on a single operand directive, such as:

    ```
              .dc.b         $xyz
    ```

    the offending statement is not flagged with an error.

4. The editor (ED.68K), when invoked using an output drive, e.g:

    ED file b:

    will not create the file on the output drive.

5. The editor (ED.68K) "Juxtapose" command does not function properly when specified with a repeat count.

6. The editor (ED.68K) X command does not respond in a friendly manner to an invalid syntax. When an invalid filename is used, such as "x23:t", the editor prints "INVALID FILENAME" and exits to the operating system. This obliterates any editing session in progress.

7. The C compiler generates an incorrect error message, "Initializer Alignment", on a statement which initializes a static unsigned or float array.

8. The C compiler does not correctly handle the modulo ("%") operator in constant expressions.

9. The C compiler will not properly substitute a macro argument inside a quoted string if the argument is preceded by a backslash escape sequence. For example,

    #define x(a) printf("\na");

    will not expand properly. Placing a space between the escape sequence and the argument fixes the problem.

10. The C compiler will not substitute a macro argument inside a quoted string if the text to be substituted contains a single quote character.

11. The C compiler will not properly handle initializations of auto variables with register variable parameters. For example:

    ```
    func(a,b)
    register int a,b;
    {
        int i=a+b;
    }
    ```

will not initialize the variable "i" to the proper value. If the parameters are not declared as "register", the initialization will work.

12. The C compiler does not properly handle expressions involving pointers with non-unique structure names. The sequence:

```
struct s1 {struct s2 *a,*b;};
struct s2 {struct s1 *b,*a;};
            .
            .
            .
q = ((p->a)->a)->a;
```

does not properly initialize "q".

13. The compiler does not properly handle byte subscript expressions involving the "++" and "--" operators. The following sequence does not work:

```
char x[100];
func() {
        char y;
        y = x[++x[0]];
```

A workaround is to rewrite the subscript expression so that the "++" operation is done before (or after) the indexing:

```
x[0]++;
y = x[x[0]];
```

14. The compiler does not properly initialize a structure which contains an array of structures.

15. The C Preprocessor will occasionally eat a line or two following a "#include" declaration. The workaround is to append some blank lines to the "#include" occurrence. This can produce some hard to track down bugs if variable declarations are lost due to the bug.

16. Conditional assembly occasionally causes loss of label immediately preceding conditional statement in the assembler.

17. The assembler can be made to generate code at an odd address by embedding odd byte length data in the text section. The assembler will not realign its program counter to an even address. The user should pad the data in the text section to an even byte boundary himself.

18. The compiler will generate an error message for:

                    struct a { long x; };
                    struct b { char x; };

    due to the non-unique member names in the structure. Make them unique.

Appendix F

Distribution Diskettes

TriSoft CP/M-68K is distributed to you on six single-sided single-density CP/M standard format diskettes. A description of each file on the diskettes is given in this manual or Appendix A of the CP/M-68K System Guide. The table below gives the general category of software found on each diskette.

Diskette #1

General utility routines for CP/M-68K (PIP, STAT, etc.) in '.REL' format.

Diskette #2

MC68000 assembler and Dynamic Debugger.

Diskette #3

'C' compiler and related routines.

Diskette #4

'C' library and 'C' ARCHIVE utility.

Diskette #5

Example BIOS and loader BIOS implementations (of interest only to those considering customization on a different hardware system). Also contains TriSoft programs for customizing CP/M-68K to your particular CP/M-80.

Diskette #6

TriSoft CP/M-68K operating system and utilities in '.68K' format.

Appendix G

BIOS Error Messages

There are two error messages which are issued from the riSoft CP/M-68K BIOS directly. They are:

IOS ERROR -- disk x not supported

The drive you have requested is not within the system configuration. Example,

    DIR C:

on a system with only two drives.

IOS ERROR -- Bad Packet

A call has been made to the CP/M-68K BIOS with a bad function number. Following the message the bad call will be displayed as:

    ***: xxxx xxxx
    ***: xxxx xxxx
      0: xxxx xxff
      1: vvvv vvvv
      ¶   ¶   ¶
      7: vvvv vvvv

where

        xxxx is a don't care

        ff   is the BIOS function number in D0.B

        vvvv is the value of the corresponding
             MC68000 data register

Note that the value of D1.L is the argument for the BIOS function.

Appendix H

Software Piracy

Many vendors are facing increasing problems with software piracy. Because of this a number of vendors have felt it necessary to resort to implementing anti-piracy schemes into the software and diskettes which you purchase. These schemes, which include diskettes which cannot be copied and software which self-destructs after a certain number of copies, do serve to make software piracy more difficult. They do not make it impossible.

TriSoft feels that such methods are not in the best interest of either TriSoft or you, the end user. It is the position of TriSoft that it is not reasonable to inconvenience, sometimes severely, the legitimate purchaser of our products in order to afford dubious additional protection.

This software is protected by the terms and conditions of the license agreement, and by the honor of our customers. We feel that no other embedded protection is necessary. With your help it will continue to be this way.

Warranty

TriSoft CP/M-68K is warranted in accordance with the terms and conditions of the LIMITED WARRANTY of Digital Research, Operating System End User License Agreement, Section 5. Nothing herein or expressed orally by any dealer or distributer of TriSoft CP/M-68K shall alter those terms and conditions.

TriSoft CP/M-68K has been tested in accordance with accepted procedures. TriSoft asserts that their CP/M-68K is a reasonable and useful single-user operating system for the MC68000 processor in Tandy TRS-80 Model-II, Model-12, and Model-16 computers.

Appendix I

The Hacker Patches

Too Much Compatibility?

One of the advantages of CP/M-68K is that it can be used by someone with CP/M-2.2 experience, with virtually no extra training. It now seems that it is so compatible that many people have trouble remembering which system they are currently in (myself among them). If you are in a user number other than user 0, the prompt for CP/M-68K is different than for CP/M-2.2; i.e.

A5>

But for user 0 you get the ubiquitous

A>

The following patch will allow you to alter the 'greater than sign' (>) in the CP/M-68K prompt to any printing character you choose. Let us suggest that this patch, if you wish to make it, be made to a copy of your master diskette and not to the master diskette itself.

This patch is to the routine CPMLIB. located on diskette #5. It may be copied to the A: diskette for patching, and then copied back to diskette #5 when you are satisfied that the patch is correct. You will need about 100k bytes of storage available on the A: diskette to perform this patch.

Boot CP/M-68K as you normally would and place a copy of diskette #5 in the B: drive.

A> PIP A:=B:CPMLIB.[V]

A> AR68 X CPMLIB CCP.O

A> DDT

```
-RCCP.O
Start = 00000400      End = 00006FFF
-S589
00000589 3E xx          [where xx is the hex code for the
0000058A 3F .           prompt character desired. Example,
```

I-1

```
-WCCP.O                    5D would give you A] for a
-©C                        prompt]
```

```
A> AR68 RV CPMLIB CCP.O
   - - -
   r ccp.o
   - - -
```

```
A> ERA B:CPMLIB.
```

```
A> PIP B:=A:CPMLIB.[V]
```

Now perform a 'custom installation' as described in section 6 of the User's Guide. The prompt for CP/M-68K will be set to the character you have choosen.

Tab Expansion:

TriSoft CP/M-68K works with the CP/M-2.2 BIOS to provide an environment compatible with both systems. This includes screen manipulation by various character codes, as well as cursor addressing capability. In some cases the horizontal TAB character (ASCII 09) is sent to the console, and this too is handled by the CP/M-2.2 BIOS. Unfortunately several CP/M-2.2 BIOS implementations on the TRS-80 did not correctly perform TAB expansion. These include Pickles&Trout PRIOR to 2.2m (they were off by one column), and LIFEBOAT (who didn't manage to expand them at all).

If you are running TriSoft CP/M-68K with a CP/M-2.2 which does NOT correctly expand tabs to the CP/M standard columns of 1,9,17,25,... then you may instruct CP/M-68K to perform the expansion. This is done with the command:

```
A> SET CON: NOTABS
```

To turn off tab expansion enter:

```
A> SET CON: TABS
```

No tab expansion is the default.

Appendix J

<u>ATON</u> <u>CP/M-2.2</u> <u>Compatibility</u>

   A problem exists when attempting to run TriSoft CP/M-
K with certain versions of ATON CP/M-2.2 for floppy disk.
'ON introduced a SECTRAN anomaly in some Level-I release
rsions (and one Level-II version) to discourage the use of
rect disk access programs. Although they have since dis-
ntinued the use of this 'feature', it still may affect
me of our customers. For the affected Level-I versions we
commend the following patch. Note that this is a change
 the ATON system, not to TriSoft CP/M-68K.

   For ATON Level-I, version 2.23E through 2.24B boot ATON
'/M-2.2 and apply the following patch:

```
A> DDT MOVCPM.COM
NEXT          PC
4000          0100
-S32B0
32B0 D2 C3
32B1 B9 .
-GO
A> SAVE 63 XMOVCPM.COM
```

u may now use XMOVCPM to build a new ATON system which
11 have the SECTRAN anomaly removed.

   ATON recommends the following action for the various
rsions of ATON CP/M-2.2:

<u>Level I</u> -- <u>64K</u> <u>Floppy</u> <u>System</u>
Release 2.21, 2.22	Get upgrade to 2.24
Release 2.23A through 2.23D	Get upgrade to 2.24
Release 2.23E through 2.24B	Apply patch
Release 2.24C and following	No action required

<u>Level II</u> -- <u>Bank</u> <u>Switched</u> <u>Floppy</u> <u>System</u>
Release 2.23	Get upgrade to 2.24
Release 2.24	No action required

<u>Hard</u> <u>Disk</u> -- <u>80K</u> <u>Radio</u> <u>Shack</u> <u>Hard</u> <u>Drive</u> <u>System</u>
All releases	No action required