

CP/M ON North Star DISK  
Double Density Version

USERS NOTES

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# CP/M on North Star Double Density Disk Users Notes

## INTRODUCTION TO THESE NOTES

This set of CP/M on North Star Disk Users Notes is intended to be used as supplementary material to the Digital Research manuals which accompany the system. It is not at all intended to serve as a stand alone guide to CP/M, but is aimed at assisting the new system owner in bringing the system up on their equipment as soon as possible. It is also aimed at informing the more experienced users about certain of the internal "hooks" and options which are specific to this particular CP/M system.

The Users Notes are divided into the following sections:

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## Section I. STARTING OUT

Upon receiving your CP/M on North Star Disk package of diskette, and manuals, the first actions to take are:

- 1) Complete and return the Registration Card
- 2) Read the manuals
- 3) Back-up the diskette

Your CP/M on North Star is a serial numbered system licensed for your use on a single computer only. Unless the Registration Card is received by Lifeboat Associates, as is required under the terms of the license, no assistance can be offered with respect to queries you may wish answered. Remember that you are acquiring a complex and

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advanced piece of software which is under constant review and improvement both at Lifeboat Associates and Digital Research. We most strongly advise you to take advantage of the fact that this is a current and evolving system, and that you ensure that you are firmly plugged into the system for disseminating news and updates about CP/M.

Initially, at the minimum, read the Digital Research manual "An Introduction to CP/M Features and Facilities" in addition to this "CP/M on North Star Double Density Disk Users Notes". Thorough reading of these will make the process of bringing up the system much smoother. For further details, the user should also refer to the manuals "CP/M Interface Guide" and "CP/M System Alteration Guide".

We most strongly advise that your first act upon receiving the system is to put on a write protect tab and then make a working copy of the distribution diskette. This may be done with the North Star DOS using the "CD" command to copy the master disk onto your work disk. If you have a single drive system, use successive "RD" and "WR" commands until the ENTIRE disk is transferred.

It is very important that you NEVER WRITE on your original distribution diskette. Put it away in a safe place until (hopefully never) needed. It will provide a last resort back-up, regardless of what happens later, in the event of hardware or software malfunction. Use the disk you just created for normal work and make additional copies of it as needed. Remember to put the proper copyright notices on any disk you make as required by Digital Research.

## Section II. PROGRAMS PROVIDED

These are programs supplied on your disk:

This first group of programs are standard CP/M distribution programs, the operation of which is described in the manual "Introduction to Features and Facilities".

MOVCPM.COM	- System relocater
ASM.COM	- Assembler
DDT.COM	- Debugger/Monitor
DUMP.COM	- Disk hex dump
ED.COM	- Editor
LOAD.COM	- Hex file loader
PIP.COM	- File interchanger
STAT.COM	- File paramaters
SUBMIT.COM	- Batch processor
SYSGEN.COM	- System read/write
DUMP.ASM	- Sample .ASM program

This second group of programs are specially designed to be used with your North Star CP/M system. They all prompt the user at each step and may be run without fear of ruining something.

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- LIST.COM - Lists directory and number of records used for each program on the disk.  
Forms are: LIST, LIST A:, LIST B:
- FORMAT.COM - Blank disk formatter  
Will format a disk in selected drive to either single or double density.
- DENSITY.COM - Mixed density program  
Converts selected drive to either single or double density to run mixed density system.
- COPY.COM - Disk copy program  
The program will prompt you to select various options to copy the CP/M system, files, etc.
- SAVEUSER.COM - Quickly writes BIOS "patches" to disk by saving the MODE byte and USER AREA of the running system onto the disk.
- CONFIG.COM - Configures the USER AREA for commonly used I/O.
- GENUSER.ASM - Source listings of various USER AREAS from the CONFIG program.

### Section III. SYSTEM REQUIREMENTS

In order to run CP/M on your computer you must have:

1. At least 24K of RAM starting at address zero.
2. A North Star double density disk system. A non-standard PROM is allowed.

### Section IV. SYSTEM LAYOUT

The CP/M system you have received is designed to run in 24K of memory and is referred to as a "22K" system. The size of the CP/M system you can run is 2K less than available memory. The numbering is done in this way to conform with the addresses and standard CP/M system sizes as referred to in the various CP/M manuals. You will find more information on the memory usage of CP/M in the Alteration Guide. In general, when references are made to a 16K system with

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bias "b", the correct bias "b" to be used is 2800 hex for a 22K system.

The CP/M system resides on the disk on tracks 0 and 1. The directory and files start on track 2. The USER AREA which will contain your I/O drivers is a one page (256 byte) area on disk at disk address 17. The USER AREA is actually the second 256 bytes of this physical disk sector of 512 bytes in North Star convention.

The following table will list the locations of various CP/M modules in both the distribution 22K system and the "SYSGEN POSITION". The "SYSGEN POSITION" is the location of the CP/M system in memory when SYSGEN or MOVCPM is run. This position is the most useful for patching the system.

Module	22K System	SYSGEN
BOOT	4000 hex	900 hex
TPA	100	not appl.
CCP	4100	0A00
BDOS	4900	1200
BIOS	5600	1F00
MODEBYTE	5AFF	23FF
USER	5B00	2400
BUFFER	5C00	2500

### Section V. SYSTEM OPTIONS

There are several user selectable options available in your CP/M system. These options are:

1. Read After Write.
2. Enable Interrupts after Disk Access.
3. Run AUTO after Warm Boot.
4. Run AUTO after Cold Boot.
5. Buffer Relocation
6. Density Select
7. Change Maximum Number of Tracks

The choice of the first four functions is controlled by the state of the bits in one byte referred to as the MODE byte. The MODE byte is located at the address immediately before the USER AREA and is at 5AFF hex in the standard 22K system (23FF hex in the SYSGEN POSITION). This address is always exactly 4FF hex above the BIOS or 4FC above the warm boot re-entry point of the BIOS. Since the warm boot re-entry point of the BIOS is always stored at location 0 in memory, programs may reference the MODE byte to manipulate it. A typical piece of code to perform this might be:

```
LHLD 1 ;Get warm boot address into HL
LXI B,4FCH ;Use BC for the double add
```

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DAD	B	;Add HL and BC registers
		;to point to MODE byte
MOV	A,M	;Fetch MODE byte

The last three options are controlled by bytes located just prior to the MODE byte. The following paragraphs describe the controlled functions and indicate the trade-offs implied by selecting the use or suppression of each feature. Also explained are the position of each bit, the sense of the bit for invoking or disabling the function and the default value used in distribution systems. In general, the bit involved must be HIGH for the feature to be ACTIVE.

### Option 1. READ AFTER WRITE

Use of Read After Write causes the system to read and verify the data on the disk after each sector is written. Any read error would result in repeated re-tries of the write and subsequent verification until the data is correctly written onto the disk. Use of this feature will cause no degradation in the speed of disk reading, but will slow disk writing by a factor of four times.

The position of this bit is value 40 hex. The distribution system is shipped with this bit LOW which causes this feature to be NOT active.

### Option 2. ENABLE INTERRUPTS AFTER DISK ACCESS

The drivers of this system disable interrupts during a disk access, since the code is real time dependent. Otherwise, an interrupt during disk access would cause an error. Since the 8080 and 8085 processors are not able to read the status of the interrupt flag, the status cannot be restored to its original condition. This feature permits the user, either in general or under program control, to exit from disk accesses with interrupts either enabled or disabled.

The position of this bit is value 10 hex. The distribution system is shipped with this bit HIGH and thus this feature is active. That is, interrupts are ENABLED on exit from a disk access.

### Option 3. RUN AUTO AFTER A WARM BOOT

Version 1.4 of CP/M includes a feature allowing execution of a command upon startup. This has applications in loading monitors into memory, initializing peripheral drivers, or causing the system to automatically enter an applications program for unskilled users. Your system has the command:

AUTO

set into it. This will cause a file AUTO.COM to be executed if the feature is invoked. The user must provide the program AUTO.COM or re-name a program to that name. The Warm Boot Auto feature will cause the command to be executed on each warm boot.

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The position of this bit is value 2. This distribution system is shipped with this bit set LOW and thus this feature is NOT active.

### Option 4. RUN AUTO AFTER A COLD BOOT

As in the previous feature, except that the command is executed only on cold boots. The position of this bit is LOW and thus this feature is NOT active.

### Option 5. BUFFER RELOCATION

Your CP/M system contains a 1K BUFFER from 5C00 to 5FFF hex in the 22K system as shipped (2500 to 28FF hex in the SYSGEN POSITION). When a COLD BOOT is done, the first 200 hex of this buffer is loaded along with the rest of the system from disk into memory. If you need more space in your USER AREA for your I/O routines, the location of this buffer may be moved, and the additional routines stored here. The location which stores the two byte address of this buffer is 5AFC in the 22K distribution system (23FC in the SYSGEN POSITION). This address would contain 5C00 hex in the 24K system as shipped. To change the buffer location, simply change the two byte address at location 23FC to your new buffer location and save the system with the re-located buffer on disk using SAVEUSER.

### Option 6. DENSITY SELECT

Your system has been designed to read and write both single and double density North Star disks. A single byte in memory controls the density of all 4 drives. That byte is located at 5AFB hex in the distribution 22K system (23FB hex in the SYSGEN POSITION). Bits 1,3,5 and 7 control the density of drives A,B,C and D respectively. The density is single if the bit is set LOW, and double is set HIGH.

The distribution system is shipped with this byte equal to 0AA hex, which means all 4 drives are set to double density. These bits may be changed "on the fly" while the system is running or any specific mixture of densities may be set and permanently saved on the disk with SAVEUSER. You will then be able to run any of the CP/M programs on your mixed density system.

The program DENSITY.COM shipped with your system manipulates this byte to allow dual density systems to be conveniently run. You may want to, for example, set drive B to single density while leaving drive A at double density to transfer programs or do other CP/M functions. It is usually best to leave drive A in double density, as any CP/M program which exits with a warm boot, as many do, will crash because there cannot be a proper double density system (as opposed to files) on a single density disk.

Read this if you have a single drive system. This is the procedure to transfer programs from single to double density using a single drive. Two changes are necessary to do this. First, make sure your drive selector plug or switch on the rear of the circuit board

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is set to enable all three drives. This is the way it is shipped from the factory. Second, change one byte in your CP/M system located at 5AF5 hex (23F5 in SYSGEN) from a zero to an 01 hex. This patch may be saved if you wish with SAVEUSER. You may now run the DENSITY program and set drive B to single density. Do not worry that there is no drive B in your system. The fixes you have just made will make CP/M "think" that you are running a double density drive A and a single density drive B. Here is a sample dialog that would be used to transfer a file named TEST.ASM from a single to double density disk. The procedure is rather cumbersome because CP/M was not really intended to be run as a single drive system, even though it can be done.

```

A>                                     Log in with double density disk
DENSITY CR                             CP/M prompt
A>                                     Run program, set B: to single density.
                                       CP/M prompt upon return
                                       Insert single density disk
B: CR                                   Login on "B:"
B>                                     CP/M prompt
DIR CR                                  Check directory of single density disk.
                                       Insert double density disk
A:DDT CR                               Bring in DDT.COM from DD disk.
                                       Insert single density disk
-                                       DDT prompt
ITEST.ASM CR                           Get file into memory with DDT
-                                       DDT prompt
R CR                                    using "I" and "R" commands.
PC      NEXT                            These next 3 lines typed by DDT
1280    100                             End and start address of program
-                                       DDT prompt
                                       Use "S" command to SET the byte
S4 CR                                    at 4 hex from 1 to a 0.
                                       This allows re-boot to A:
0004 01                                 DDT responds
0 CR                                     You type to set byte
0005 00                                 DDT goes to next byte.
-                                       Type ". CR" to exit "S" mode.
                                       DDT prompt
                                       Insert double density disk
GO CR                                    Do a warm boot
A>                                     CP/M prompt
SAVE 18 TEST.ASM CR                    Save 18 pages of program

```

Note that the correct number of (256 byte) pages to SAVE is given by the hex address given by DDT. Take the first two digits under "PC", convert from hex to decimal, and SAVE that number of pages.

## Option 7. CHANGE MAXIMUM NUMBER OF TRACKS



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The maximum number of tracks which can be accessed by the system is set by a byte in memory called NTRKS. NTRKS is located at 5AFA hex in the distribution 22K system (23FA hex in the SYSGEN POSITION). The distribution disk is shipped with NTRKS set to 35, which is the correct number for the Shugart drives shipped by North Star. If you have a drive with larger capacity, such as a Pertec with 40 track capacity, this byte may be changed. If you do so, you must also change a byte called DDMAXALL located at 5AEC hex in the distribution 22K system (23EC hex in the SYSGEN POSITION). DDMAXALL is currently set to 164 decimal (0A4 hex), which is one less than the maximum number of 1K file blocks which the CP/M system can access with a 35 track drive. This is calculated by multiplying 33 available file tracks (not including 2 system tracks) times 10 (512 byte) sectors per track divided by 2 sectors per (1K) block. For example, DDMAXALL would be changed from 164 decimal to 189 decimal for 40 track drives. This change will NOT affect single density. Both NTRKS and DDMAXALL may be saved with SAVEUSER. The FORMAT program is now set for 35 tracks. Look at the ASCII message at the beginning of the program with DDT to find a location to patch in more tracks.

### Section VI. MISCELLANEOUS CP/M INFORMATION

1. You may get the error message LOAD ERROR when trying to run a long program under CP/M. This means the program you are attempting to run is too large for the current size CP/M system you are using. The cure for this is to use the MOVCPM program provided on your disk to generate a larger size system. Use STAT.COM to find the size of the program you wish to run. Then generate a CP/M system 7K larger. For example, if the program has a size of 29K as given by STAT, you must generate a 36K CP/M by using the command:

```
MOVCPM 36 CR
```

You may alternatively automatically generate the largest possible CP/M system that can fit into your available memory space by giving the command:

```
MOVCPM * CR
```

2. CP/M stores files on disk in a logically skewed order. That is, if a file is 5 sectors long, CP/M would not necessarily store it on sectors 1,2,3,4 and 5 in that order but might use a different sequence in order to make disk access times faster. This only applies to files, the system tracks (tracks 0 and 1) are in straight numerical order.

In double density CP/M each 512 byte physical sector on the disk is re-numbered for CP/M as four 128 byte sectors. For example, 512 byte sector 0 would be CP/M sectors 1,2,3 and 4. You will note in the table below that every four adjacent sectors are in numerical order, since they are actually one physical 512 byte sector. The sequence used in double density CP/M is:

```
(1,2,3,4),(21,22,23,24),(5,6,7,8),(25,26,27,28),(9,10,11,12)  
(29,30,31,32),(13,14,15,16),(33,34,35,36),(17,18,19,20),(37,38,39,40)
```

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In single density CP/M on North Star each 256 byte physical sector on the disk is re-numbered for as two 128 byte sectors. The sequence for single density CP/M on North Star happens to come out in numerical order and is given by this table:

1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20

3. You must format raw diskettes before use with the program FORMAT.COM. This ensures that the disk has been properly initialized for CP/M. Just give the command "FORMAT CR" and the program will ask you which drive to use. The disk is ready for use after FORMAT runs, and whether to format in single or double density. Alternatively, you may use the North Star DOS "IN" command but if you do, the first time that disk is used by CP/M you must initialize the directory with the command: "ERA \*.\* CR". CP/M will ask "ALL FILES Y/N?" and your response should be "Y CR".

## Section VII. BOOTING UP THE SYSTEM

The purpose of this section is to guide you in getting your CP/M system running for the first time. This is a two stage process. The first stage, covered in this section, is to bring the CP/M system into memory. The second stage, covered in the next section "CONFIGURING YOUR I/O", involves permanently customizing the system for your specific I/O. We suggest you read both sections as a unit several times to get a "feel" for the procedures. Then start right here, do this section first and then the next.

First make sure you have at least 24K of RAM memory starting at 0. Also MAKE SURE you are using a "working" disk which is a COPY of the distribution diskette. All tracks should have been copied. DO NOT USE THE ORIGINAL.

There are two methods of booting up. One is the DOS method which has been designed to be as easy and painless as possible. Use this method if possible because it will give you immediate console control of the system and is a quick and positive test of the system and your equipment. The other is the NORMAL method which you will always use when more familiar with the system. Although you do not gain immediate console control, this much more general method may always be used. Pick either the DOS or NORMAL method, go to the section on the method you have selected, do that procedure and then go to the next section on "CONFIGURING YOUR I/O". Throughout this text, CR in a command means a carriage return.

### Method 1. DOS METHOD

This method may ONLY be used if your PROM is in the standard 0E800 hex location and your North Star DOS is in the standard 2000 hex location. Use the NORMAL method if either of these differ. This DOS method does it's I/O through your existing North Star DOS user area. Whatever you have previously patched into the area of North Star DOS between 2900 and 29FF hex will now be temporarily used by CP/M until a more permanent I/O is installed into the CP/M system itself. This is the procedure:

- Step 1. Boot in your North Star DOS in the usual fashion.
- Step 2. Insert the working copy CP/M diskette in drive A.
- Step 3. Type the command: GO CPM CR
- Step 4. Your system should come up with the sign-on message:

```
CP/M on North Star Disk
22K Version 1. 44
Copyright (C) 1979 Lifeboat Associates
```

A>

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Congratulations, your system is on the air. Please remember that your I/O is being done thru North Star DOS, which is right in the middle of where many CP/M programs run. This is only designed to be a TEMPORARY system until your own I/O drivers have been patched in.

In the meantime, you may use all the built-in functions such as DIR, TYPE, ERA, REN and SAVE. You may also use (ONLY) the COM programs DDT, LIST, STAT, DENSITY, SAVEUSER and CONFIG. Don't try to run any of the others, the system will crash. Now go to the section on "CONFIGURING YOUR I/O" to make the permanent I/O patches in your system.

### Method 2. NORMAL METHOD

This method can be used with both standard and non-standard PROM or DOS addresses. The system makes any necessary adjustments when it is booted in. The NORMAL method works by using the PROM to load the CP/M system into the proper memory area. If the system has been previously configured it will simply sign-on and be ready to run. If your I/O has not been previously configured, a special program called CONFIG will be automatically loaded which may be used by you to customize the system with your specific I/O as explained in the section "CONFIGURING YOUR I/O". You may optionally pre-configure the system by transferring the I/O area from an existing single density CP/M disk as explained in the next paragraph. Do so now if you elect. Then go to NORMAL BOOT PROCEDURE.

### USING EXISTING SINGLE DENSITY USER AREA

Do this only if you have been running single density CP/M on North Star. Otherwise, go directly to NORMAL BOOT PROCEDURE.

This procedure will allow you to transfer the USER AREA currently in your single density CP/M system to your new double density system. This method has the advantage that your system will immediately sign-on without going thru the configuration procedure in the next section. This is the procedure to use if your I/O is complex or not covered in the list of standard terminals which can be automatically configured by CONFIG. The existing single density CP/M from which you will take the USER AREA must be exactly 22K in system size. USER AREA size is limited to one page of 256 bytes in the double density system.

- Step 1. Boot in double density North Star DOS.
- Step 2. Insert new double density CP/M disk.
- Step 3. Read in 512 bytes of new disk using DOS command:  
RD 17 100 1 CR  
New USER AREA is now at 200 hex ready to modify.
- Step 4. Insert old single density CP/M disk.
- Step 5. Overlay above with old USER AREA using command:  
RD 28 200 1 S CR
- Step 6. Re-insert new double density disk.
- Step 7. Write USER AREA back to double density disk using DOS command:

WR 17 100 1 CR

NORMAL BOOT PROCEDURE

Step 1. Boot in your North Star DOS in the usual fashion. This ensures that your hardware has been properly initialized. If you can't do this, just go to the next step.

Step 2. Insert the (COPY of distribution diskette) working CP/M diskette in drive A.

Step 3. Run the computer from the entry point of your PROM which is normally 0E800 hex but may be another address if non-standard. If your North Star DOS is running, type the command:

JP E800 CR (or non-standard address).

If DOS is not running, use your monitor, front panel switches or whatever other facilities you have to jump to E800 hex (or non-standard address) to boot in the system.

Step 4. If you have a single density CP/M on North Star and have already modified the USER AREA on your double density by writing onto it the old single density USER AREA, (as explained in the previous paragraph) the system will now sign-on. The system is running and you have completed the boot-up procedure. Otherwise, go on to the next step.

Step 5. Your disk will be accessed and then stop. You will NOT get any message on the console. What happened was that the CP/M system was brought into memory and it then loaded and ran CONFIG. The CONFIG program is designed to come to a halt until you go thru the steps in the "CONFIGURING YOUR I/O" in the next section.

TO GENERATE NEW VERSION FROM 22K VERSION

A) BOOT 22K VERSION

B) RUN MOVCPM

A> MOVCPM 56 \* ↓

SIZE

C) RUN SYSGEN

A> SYSGEN ↓

IMPORTANT  
SKIP

SOURCE DRIVE NAME (OR RETURN TO SKIP) ↓

DESTINATION DRIVE NAME (OR RETURN TO REBOOT) A ↓

D) PATCH I/O AREA (USING ROM MONITOR)

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Section VIII. CONFIGURING YOUR I/O

Your CP/M on North Star system includes a program called CONFIG.COM which is designed to automatically patch the USER AREA of your system for a variety of different I/O devices. The USER AREA is defined as a one page (256 bytes) area in the CP/M system which begins with a table of jumps to your individual I/O routines. This table is accessed by other parts of the system. The actual I/O routines themselves are usually located in the remaining (approximately 240) bytes of the USER AREA. They may alternatively be located in PROM or a different part of RAM above the CP/M system. The I/O conventions in the Digital Research manual "System Alteration Guide" apply.

The CONFIG program contains a variety of prototype USER AREAS for different I/O devices in common use. The list of I/O devices included in CONFIG is given below. When run, CONFIG automatically inserts proper port numbers, status bit information and memory addresses into the prototype USER AREA, then moves the prototype to a temporary PATCH AREA located at 200 hex in memory for possible further modification by you, and finally moves the entire PATCH AREA to the USER AREA. You may accomplish this entire operation either in a single step if you have a standard configuration or in multiple steps if extensive patching is required.

If you used the NORMAL method of boot-up, the first part of CONFIG has been run and your system is halted and seems to be dead. Relax, it's just waiting for the next part, by doing a "soft halt" (jump to itself) at memory location 103 hex.

If you used the DOS method of boot-up, you must now get to this same stage by loading CONFIG. To do this, type:

```
DDT CONFIG.COM CR
```

DDT will sign on in the normal manner, and CONFIG will be in memory waiting to be run. This method has the advantage that you can use the facilities of DDT to help configure the system. Having DDT makes it easier to do the next step.

We are now ready to configure the system. Look in the table of configurations for the one pertaining to your I/O devices. Refer to APPENDIX A for the specific details and listings of each of these configurations.

LIST OF STANDARD TERMINALS

0. Altair 88-2SIO
1. Imsai SIO2
2. Altair SIO (Rev Non-Zero)
3. Altair SIO (Rev Zero)
4. Processor Technology 3P+3
5. Imsai MIO
6. Altair 88-4PIO
80. Compal 80
81. Processor Technology SOL

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- 82. Xitan SMB (Zapple)
- 83. North Star Horizon
- 84. Vector Graphic MZ

If your I/O device is listed, go to the heading on CONFIGURING FOR A STANDARD TERMINAL. If it is not listed, go to CONFIGURING FOR A NON-STANDARD TERMINAL.

### CONFIGURING FOR A STANDARD TERMINAL

FIRST, use whatever facilities you have to deposit the configuration number of your choice in memory location 120 hex. If you used the DOS method and have the use of DDT, use the "S" command in DDT. Else, use your monitor, front panel switches or whatever it takes to get that number into location 120 hex.

SECOND, use whatever facilities you have to RUN from location 100 hex. If you have DDT, use the "G" command by typing:

```
G100 CR
```

Else, use your monitor or front panel switches.

You should get a sign-on message of the form:

```
CONFIG Version 1.3
Copyright (C) 1979 Lifeboat Associates
Your CP/M System is now configured.
Type SAVEUSER to permanently save on disk.
A>
```

At this point you should have a working system patched in memory with your I/O. It may be permanently written on the disk with the SAVEUSER program by typing:

```
SAVEUSER CR
```

The program will prompt you what to do. You should now test the system by doing a COLD BOOT. This brings in a totally fresh system from disk and is a good test of whether your patches were right. To do this, use your monitor, reset switch, front panel or whatever to boot in the system in exactly the same way you boot in the North Star DOS. It is best to cycle the computer AC power (after first removing all diskettes) before this test to wipe memory clean and perform a definite test of your device initialization.

### CONFIGURING FOR A NON-STANDARD TERMINAL

At this point, the system is in memory, has loaded the CONFIG program, and is ready for the USER AREA at 5B00 hex to be patched with your individual console I/O. If you used the DOS method to boot-up, you have the use of DDT. Otherwise the system has loaded CONFIG and has come to a halt.

Using CONFIG for a non-standard terminal is a two step process. First, you must put a copy of your proposed USER AREA into a PATCH AREA located at 200 hex in memory. You may use CONFIG to do this, or patch in the code with your own monitor or front panel switches. Second, use CONFIG to move this PATCH AREA to the USER AREA where it

will actually run. You will find sample USER AREAs in the Appendix to serve as a guide.

After each step in running CONFIG, control will return to location 103 hex, which is normally a soft halt. That is, the computer will continuously loop at that address and seem to be stopped. If you have the use of DDT or another monitor, you may return to that monitor instead of stopping. To do this, use your monitor to store the entry address of your monitor at location 104 hex. For example, if you used the DOS method, use the "S" command of DDT to store a 0038 hex which is the re-entry address of DDT. You would store a 38 hex (which is the low byte of the address) at location 104 hex and a 0 (the high byte) at location 105 hex. This will cause CONFIG to return to DDT after you have run the program.

It is now necessary to decide if any of the standard configurations offer anything, so that modifying them is advantageous over starting from scratch. In particular, configuration numbers 0 thru 6 are standard teletype drivers which are used in many different systems. You may have to change the port numbers or the status bits but the subroutines are probably otherwise correct.

If you think one of the standard configurations is a good starting point, pick the one you want, and use your facilities to store the appropriate configuration number at 120 hex as explained above. Then use your facilities to jump to 106 hex which will produce the configuration you have selected and store it in the PATCH AREA starting at memory location 200 hex without making any change in your system USER AREA. The purpose of storing the configuration at the PATCH AREA is to allow you to conveniently modify it. Use your monitor to change the partially configured PATCH AREA to one you think might work.

If you don't think one of the standard configurations is a good starting point, use your monitor or front panel switches to patch in an entire prototype USER AREA. These patches must be inserted in the PATCH AREA. All address references in calls and jumps must be the ones desired in the final running system. CONFIG will not change any of the addresses. It will simply move the entire block of memory up to the USER AREA. Be sure to begin with the table of jumps in proper order. In appendix A you will find a listing of a sample user area using the teletype driver. Although this will not apply exactly to your case, it will serve as a guide for you to patch the system for your needs. The important thing in the beginning is to patch at least the drivers for CINIT, CONIN and CONOUT. The other jumps can be terminated with simple RETURNS until you wish to further patch your system.

Try out your patches by running CONFIG from memory location 109 hex. This will cause CONFIG to move the entire PATCH AREA at 200 hex to the USER AREA at 5B00 hex. CONFIG will then call the first jump in the USER AREA jump table which should jump to the code necessary to initialize your I/O devices. CONFIG will then attempt to do a WARM BOOT and sign on. If the system does sign on, you may save your patches on disk using SAVEUSER and then test your patches



by trying a COLD BOOT as explained in the previous section. If the system doesn't sign on, there is something wrong in your I/O routines. Since everything may have crashed, it is best to start fresh in this case. Keep at it until you see the CONFIG sign-on message on the screen.

## Section IX. CHANGING THE I/O CONFIGURATION

The purpose of this section is to explain how to make changes in your I/O after the system is up and running. You may wish to implement a printer, have more than one console or many other variations on the basic console I/O that you began with. There are two methods of doing this. The SYSGEN PROCEDURE is a comprehensive method of making system changes. SAVEUSER is a quick and easy method of making short patches.

### SYSGEN PROCEDURE

The following procedure will be referred to as the "SYSGEN PROCEDURE" for changing your system. This is an advanced procedure and should only be used after your system has been properly running and you are familiar with the system and the use of the ED.COM, ASM.COM, SYSGEN and DDT. It uses the facilities of CP/M to create an assembly language file containing your customized I/O. The existing system is then brought into memory at location 900 hex, which is referred to as the "SYSGEN POSITION". This is the standard and most convenient memory location for making changes in the CP/M system. The program resulting from your assembly language file is then inserted into the USER AREA of the system while in the SYSGEN POSITION and the new system is then written onto the disk.

The file GENUSER.ASM contains many different types of I/O. Changes may be made in this file to suit your own purposes and then implemented in your system. Pick out the most useful sections and modify this file using the CP/M editor ED.COM. Make sure any of the unused prototype USER AREAS in GENUSER.ASM are deleted. Also make sure your USER AREA has a proper ORG statement at BIOS+500 hex. Then assemble the changed file using the CP/M assembler ASM.COM. This will produce a file called GENUSER.HEX. Use SYSGEN.COM to GET a copy of the existing system into memory at the SYSGEN POSITION and save that as a file by the command "SAVE 36 CPM<sup>22</sup>.COM". Now make sure you are logged in on the same drive as the GENUSER.HEX file so that it can be inserted by DDT. Bring the existing system back to the SYSGEN POSITION by the command "DDT CPM<sup>22</sup>.COM". Now overlay the original USER AREA (2400 to 24FF hex) with your new GENUSER.HEX file using the two commands "IGENUSER.HEX" and "R<OFFSET>". OFFSET for a 22K system is 0C900 hex. For other size systems the correct OFFSET is given in the GENUSER.ASM file and represents the difference from where the USER AREA actually runs in memory (at 5B00 hex for a 22K system) to its location in the SYSGEN POSITION which is always 2400

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hex. Now you have a patched CP/M system in memory in the SYSGEN POSITION ready to be saved as a file by the command "SAVE 36 C24PAT.COM". Finally, this patched system may be put on your disk by the command "SYSGEN C24PAT.COM". SYSGEN will ask which drive you wish to put the system on and we suggest drive B: so you do not overwrite your old system until you are absolutely sure the new one works properly. Now the patched system is on B: ready to be inserted in drive A: and cold booted. It may be helpful for you to know that SYSGEN can always be run with a system in memory at the SYSGEN POSITION without disturbing that system.

### SAVEUSER

If you wish to make quick and simple patches in your system without going thru the above procedure, we have included a file called SAVEUSER.COM. When SAVEUSER is run, it will write onto your drive A: disk the patched user area so that when you boot up in the future, these changes will be in your system. SAVEUSER can also be used to patch the system on your disk when the various SYSTEM OPTIONS are changed. SAVEUSER writes the two sectors containing the USER AREA and the previous sector from memory in the running system to the proper area on disk. You may therefore make a change in the running system, such as a MODE byte change, test it's operation and then permanently save that change.

APPENDIX A - SAMPLE USER AREA LISTING

```

;
;GENUSER                                MARCH 1, 1979

```

```

000A =    PAGE    0
          VERS    EQU    10

```

```

;
;GENERAL USER AREAS FROM CONFIG

```

```

;THESE USER AREAS ARE DUPLICATES OF WHAT CONFIG WOULD PRODUCE.
;THEY MAY BE USED AS A BASIS FOR MODIFYING YOUR OWN ROUTINES.
;IN ACTUAL USE, YOU MUST PICK *** ONLY ONE ***

```

```

;
;*****
;*** SIMPLE TELETYPE DRIVER ***
;*****

```

```

0016 =    MSIZE    EQU    22                ;DECIMAL SIZE OF SYSTEM
5600 =    BIOS     EQU    (MSIZE*1024)-200H ;STANDARD CP/M CONVENTION
5B00 =    USER     EQU    BIOS+500H        ;LOCATION TO USER AREA
C900 =    OFFSET    EQU    1F00H-BIOS      ;TO SYSGEN IMAGE
0003 =    IOBYT    EQU    3                ;PAGE 0 LOCATION
          ;JUMPS MUST REMAIN HERE, IN SAME ORDER
          ORG      USER

```

```

;
; TEMPORARY CONSOLE DEVICE ASSIGNMENTS
; FILLED IN BY CONFIG WITH OTHER PORTS/MASKS
; THESE ARE VALID FOR CONFIGURATION 2

```

```

0000 =    TTS      EQU    0                ;CONSOLE STATUS PORT
0001 =    TTI      EQU    1                ;CONSOLE DATA INPUT PORT
0001 =    TTO      EQU    TTI             ;CONSOLE DATA OUTPUT PORT
0001 =    RDA      EQU    1                ;INPUT READY MASK
0000 =    RDAMSK   EQU    0                ;MASK TO CONVERT TO ACTIVE LOW
0080 =    TBE      EQU    80H             ;OUTPUT READY MASK
0000 =    TBEMSK   EQU    0                ;MASK TO CONVERT TO ACTIVE LOW

```

```

;
;*** USER AREA JUMP TABLE ***

```

```

TTY0:
5B00 C3595B    JMP      TTYCINIT           ;BASE OF JUMP TABLE
5B03 C3205B    JMP      TTYST              ;COLD INITIALIZATION
5B06 C3305B    JMP      TTYIN              ;CONSOLE STATUS
5B09 C3405B    JMP      TTYOUT             ;CONSOLE INPUT
5B0C C3405B    JMP      TTYLIST            ;CONSOLE OUTPUT
5B0F C3405B    JMP      TTYPUNCH           ;LIST OUTPUT
5B12 C3305B    JMP      TTYREADER          ;PUNCH OUTPUT
5B15 C3505B    JMP      TTYPRST            ;READER INPUT
5B18 000000    DB        0,0,0          ;PRINTER STATUS NOT IMP
5B1B 8000      DW      TTYLEN          ;LENGTH
5B1D 000000    DB        0,0,0

```

```

;
;*** CONSOLE STATUS CHECK ROUTINE ***
TTYST:      ;RET ACC=0 IF NO KEY, ACC=0FFH IF KEY

```

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```

5B20 DB00          IN      TTS          ;GET STATUS
5B22 00           NOP
5B23 E601         ANI      RDA          ;AND WITH STATUS BITS
5B25 EE00         XRI      RDAMSK      ;MAKE ACTIVE LOW
5B27 3E00         MVI      A,0         ;NO KEY FLAG
5B29 C0           RNZ
5B2A 2F           CMA          ;NO KEY WAITING
5B2B C9           RET          ;KEY FLAG OFFH
5B2C 00000000     DB      0,0,0,0     ;KEY CHAR WAITING

```

```

;
;*** CONSOLE INPUT ROUTINE ***

```

```

TTYREADER:      ;NOT IMPLEMENTED
TTYIN:

```

```

5B30 DB00          IN      TTS          ;GET STATUS
5B32 00           NOP
5B33 E601         ANI      RDA          ;AND WITH STATUS BITS
5B35 EE00         XRI      RDAMSK      ;MAKE ACTIVE LOW
5B37 C2305B       JNZ      TTYIN        ;LOOP UNTIL READY
5B3A DB01         IN      TTI          ;GET CHR FROM DATA
5B3C 00           NOP
5B3D E67F         ANI      7FH         ;STRIP PARITY
5B3F C9           RET          ;DONE

```

```

;
;*** CONSOLE OUTPUT ROUTINE ***

```

```

TTYLIST:        ;NOT IMPLEMENTED
TTYPUNCH:       ;NOT IMPLEMENTED
TTYOUT:

```

```

5B40 DB00          IN      TTS          ;GET STATUS
5B42 00           NOP
5B43 E680         ANI      TBE          ;AND WITH STATUS BITS
5B45 EE00         XRI      TBEMSK      ;MAKE ACTIVE LOW
5B47 C2405B       JNZ      TTYOUT        ;LOOP UNTIL READY
5B4A 79           MOV      A,C         ;INTO ACC FOR OUT
5B4B D301         OUT      TTO          ;OUTPUT IT
5B4D 00           NOP
5B4E C9           RET          ;DONE
5B4F 00           NOP

```

```

;
;*** PRINTER STATUS CHECK ***

```

```

TTYPRST:
5B50 000000      NOP ! NOP ! NOP
5B53 AF          XRA      A          ;NO CHAR READY
5B54 C9          RET
5B55 00000000    NOP ! NOP ! NOP ! NOP

```

```

;
;*** COLD INIT ROUTINE ***

```

```

TTYCINIT:      ;DEVICE INIT MOVED TO HERE
5B59 C9          RET
5B5A            DS      38

```

```

;
0080 =         TTYLEN EQU      $-TTY0
;*** END OF SIMPLE TELETYPE DRIVER ***

```

```

;
;
;

```

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```

;
;
;*** OTHER TELETYPE CONFIGURATIONS ***
;
;THE CORRECT PORT NUMBERS, STATUS BITS AND MASKS
;FOR EACH CONFIGURATION IS INSERTED INTO THE
;GENERAL ROUTINE ABOVE BY CONFIG.
;THEY ARE OBTAINED FROM THE FIRST LINE
;OF DATA BYTES FOR EACH CONFIGURATION.
;
;THE ORDER OF THE DATA BYTES IS:
;      TTS, TTI, TTO, RDA, RDAMSK, TBE, TBEMSK
;
;THEN, THE INDIVIDUAL INITIALIZATION ROUTINES
;ARE MOVED INTO PLACE AT TTYCINIT.
;
;THE CODE FROM HERE DOWN, ALTHOUGH ASSEMBLED IN
;THIS EXAMPLE, IS NOT MOVED INTO THE USER AREA BY CONFIG.
;ONLY THE SPECIFIC BYTES NEEDED ARE SELECTIVELY
;INSERTED INTO THE ABOVE GENERAL HANDLER BY CONFIG
;WHEN YOU SPECIFY A CONFIGURATION NUMBER.

```

```

;
;CONFIGURATION 0-- ALTAIR 88-2SIO
;      OR OTHER SIO USING MOTOROLA 6850 UART

```

```

5B80 1011110101CNFG0: DB      16,17,17,1,1,2,2
5B87 09                DB      9                ;INIT LENGTH
                    INIT0:                ;INIT ROUTINE
5B88 3E03              MVI      A,3              ;RESET 6850
5B8A D310              OUT      16              ;PROGRAM FOR 8 BITS
5B8C 3E11              MVI      A,11H           ;2STOP,NOPARITY
5B8E D310              OUT      16              ;16 CLOCK
5B90 C9                RET                    ;DONE

```

```

;
;CONFIGURATION 1--IMSAI SIO2
;      OR OTHER SIO USING THE INTEL 8251 USART

```

```

5B91 0302020202CNFG1: DB      3,2,2,2,2,1,1
5B98 11                DB      17              ;INIT LENGTH
                    INIT1:                ;INIT ROUTINE
5B99 3EAA              MVI      A,0AAH           ;DUMMY MODE BYTE
5B9B D303              OUT      3
5B9D 3E40              MVI      A,40H           ;RESET
5B9F D303              OUT      3
5BA1 3ECE              MVI      A,0CEH           ;MODE INSTRUCTION
5BA3 D303              OUT      3
5BA5 3E37              MVI      A,37H           ;COMMAND INSTRUCTION
5BA7 D303              OUT      3
5BA9 C9                RET                    ;DONE

```

```

;
;CONFIGURATION 2-- ALTAIR SIO A,B,C (NOT REV 0) - OLD MITS
;      OR OTHER UART TYPE SERIAL I/O BOARD
;      NOT REQUIRING INITIALIZATION

```

```

AA 0001010100CNFG2: DB      0,1,1,1,0,80H,0
5BB1 01                DB      1
                    INIT2:                ;INIT ROUTINE
5BB2 C9                RET

```

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```

;
;CONFIGURATION 3 -- ALTAIR SIO A,B,C (REV 0)
5BB3 0000000101CNFG3: DB 0,0,0,1,1,20H,20H,20H,20H,2,2
5BBE 01 DB 1
INIT3: ;INIT ROUTINE
5BBF C9 RET ;DONE
;
;CONFIGURATION 4-- PROCESSOR TECHNOLOGY 3P+S SERIAL I/O
5BC0 0000000101CNFG4: DB 0,0,0,1,1,40H,40H,40H,40H,80H,80H
5BCB 01 DB 1
INIT4: ;INIT ROUTINE
5BCC C9 RET ;DONE
;
;CONFIGURATION 5-- IMSAI MIO SERIAL I/O
5BCD 4342420202CNFG5: DB 43H,42H,42H,2,2,1,1
5BD4 04 DB 4 ;INIT LENGTH
INIT5: ;INIT ROUTINE
5BD5 AF XRA A
5BD6 D343 OUT 43H
5BD8 C9 RET ;DONE
;
;CONFIGURATION 6 -- ALTAIR 88-4PIO
; OR OTHER PIO USING THE MOTOROLA 6820 PIA
5BD9 1011138080CNFG6: DB 16,17,19,80H,80H,3,3
5BE0 11 DB 17 ;INIT LENGTH
INIT6: ;INIT ROUTINE
5BE1 AF XRA A ;SELECT DATA DIRECTION
5BE2 D310 OUT 16 ;REGISTER AND SET
5BE4 D311 OUT 17 ;PORT A=IN
5BE6 D312 OUT 18 ;PORT B=OUT
5BE8 2F CMA
5BE9 D313 OUT 19 ;CA2/CB2=OUTPUT
5BEB 3E24 MVI A,24H ;LEVEL HANDSHAKE
5BED D310 OUT 16
5BEF D312 OUT 18
5BF1 C9 RET ;DONE
;
;
;*****
;*** SPECIAL CONFIGURATIONS ***
;*****
;
;
;*****
;SPECIAL CONFIGURATION 80 -- COMPAL 80
; TERMINAL I/O DONE THROUGH THE COMPAL MONITOR
; INTERRUPTS MUST BE ENABLED
;*****
;
0016 = MSIZE EQU 22 ;DECIMAL SIZE OF SYSTEM
5600 = BIOS EQU (MSIZE*1024)-200H ;STANDARD CP/M CONVENTION
5B00 = USER EQU BIOS+500H ;LOCATION TO USER AREA
C900 = OFFSET EQU 1F00H-BIOS ;TO SYSGEN IMAGE
;JUMPS MUST REMAIN HERE, IN SAME ORDER

```

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```

B00
;
; PAL0: ;COMPAL USER AREA JUMP TABLE
5B00 C31D5B JMP PALCINIT
5B03 C3295B JMP PALST
5B06 C31E5B JMP PALCI
5B09 C3245B JMP PALCO
5B0C C3245B JMP PALLIST
5B0F C3245B JMP PALPUNCH
5B12 C31E5B JMP PALREADER
5B15 C3325B JMP PALPRST
5B18 000000 DB 0,0,0
5B1B 3400 DW PALLEN ;LENGTH

PALCINIT:
5B1D C9 RET ;INIT BY COMPAL MONITOR

PALCI:
PALREADER:
5B1E CDADE0 CALL 0E0ADH ;CHR IN COMPAL MONITOR
5B21 E67F ANI 7FH
5B23 C9 RET

PALCO:
PALLIST:
PALPUNCH:
5B24 79 MOV A,C
5B25 CDC2E0 CALL 0E0C2H ;CHR OUT COMPAL MONITOR
5B28 C9 RET

PALST:
5B29 FB EI
5B2A 3AFDED LDA 0EDFDH ;CHR FROM INTERRUPT KEYBRD
5B2D B7C8 ORA A ! RZ
5B2F 3EFF MVI A,0FFH
5B31 C9 RET

PALPRST:
5B32 AFC9 XRA A ! RET
0034 = PALLEN EQU $-PAL0
;
;
;*****
;SPECIAL CONFIGURATION 81 -- PROCESSOR TECHNOLOGY SOL-20
; WITH SOLOS 1.3
;*****
;
0016 = MSIZE EQU 22 ;DECIMAL SIZE OF SYSTEM
5600 = BIOS EQU (MSIZE*1024)-200H ;STANDARD CP/M CONVENTION
5B00 = USER EQU BIOS+500H ;LOCATION TO USER AREA
C900 = OFFSET EQU 1F00H-BIOS ;TO SYSGEN IMAGE
;JUMPS MUST REMAIN HERE, IN SAME ORDER

5B00
ORG USER
;
; SOLO: ;SOL USER AREA JUMP TABLE
5B00 C31E5B JMP SCINIT
5B03 C33B5B JMP SCONST
5B06 C3715B JMP SCONIN
5B09 C39C5B JMP SCONOUT
5B0C C3A25B JMP SLIST

```

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```

5B0F C3AA5B      JMP      SPUNCH
5B12 C3775B      JMP      SREADER
5B15 C3E05B      JMP      SPRSTAT
5B18 000000      DB       0,0,0
5B1B EE5B        DW       SOLLEN          ;LENGTH

;
;*** SOL EQUATES ***
C000 =          SOLOS EQU      0C000H
C800 =          SOLRAM EQU     SOLOS+800H
C019 =          SOUT  EQU      SOLOS+19H
C01C =          AOUT  EQU      SOUT+3
C01F =          SINP  EQU      AOUT+3
C022 =          AINP  EQU      SINP+3
C800 =          UIPRT EQU      SOLOS+800H      ;STORE LOC OF USER INPUT PORT
C802 =          UOPRT EQU      SOLOS+802H      ;STORE LOC OF USER OUTPUT PORT

;
;EQUATES FOR SELECTION OF SOL PSEUDO-PORTS
0000 =          CON    EQU      0              ;KEYBOARD AND VIDEO
0001 =          RDR    EQU      1              ;SERIAL PORT
0001 =          PUN    EQU      1              ;SERIAL PORT
0002 =          LST    EQU      2              ;PARALLEL PORT
IOSET:          ;INITIAL IOBYT MAPPING STORED HERE
                ;CHANGE TO SELECT OTHER DEVICES
5B1D 94         DB       LST SHL 6 + PUN SHL 4 + RDR SHL 2 + CON

;
SCINIT:         ;INSERT YOUR COLD INIT HERE IF NEEDED
5B1E 000000     NOP ! NOP ! NOP          ;USER SPACE
SOLINIT:       ;INIT FOR SOL-20
5B21 AF         XRA      A
5B22 D3FA       OUT     0FAH          ;SHUT OFF SOL TAPES
5B24 3A1D5B     LDA     IOSET         ;PICK UP INITIAL IOBYT
5B27 320300     STA     IOBYT        ;STORE INITIAL IOBYT MAPPING

;
;BE SURE TO INITIALIZE SOLOS IF YOUR DEVICES ARE MAPPED
;INTO THE IOBYT - USE THIS ROUTINE WITH YOUR OWN VECTORS.
00C9 =          USERIN EQU     0C9H          ;RETURNS UNTIL
00C9 =          USEROUT EQU    0C9H         ;DEVICES SETUP
5B2A 21C9002200 LXI H,USERIN ! SHLD UIPRT
5B30 21C9002202 LXI H,USEROUT ! SHLD UOPRT
5B36 C9         RET                ;END OF INITIALIZATION

;
SWINIT:        ;PUT YOUR WARM INIT ROUTINE HERE
5B37 000000     NOP ! NOP ! NOP          ;USER SPACE
5B3A C9         RET

;
SCONST:       ;PUT YOUR STATUS ROUTINE HERE
                ;RET Z SET AND A=0 IF NO KEY
                ;RET NZ AND A=0FFH IF KEY
5B3B 3A0300     LDA     IOBYT
5B3E E603       ANI     3
SOLST:        ;GENERAL SOL CONSOLE STATUS
                ;ENTER WITH ACC= 0-3 FOR DEVICE SELECT
                ;STORE CHAR INPUTTED (OR 80H IF NO KEY)
5B40 22EA5B     SHLD   SAVHL          ;SAVE HL
5B43 60         MOV    H,B

```



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```

5B44 69          MOV      L,C
5B45 22EC5B     SHLD    SAVBC          ;AND BC REGS
5B48 4F         MOV      C,A          ;DEVICE SELECT
5B49 0600       MVI      B,0
5B4B 21E65B     LXI      H,CHAR0
5B4E 09         DAD      B          ;POINT TO CHAR FOR DEVICE
5B4F 22E45B     SHLD    PTCHAR
5B52 7E         MOV      A,M          ;80H IF NO CHAR
5B53 FE80       CPI      80H          ;CHAR THERE?
5B55 C2665B     JNZ     CSKEY          ;YES
                    ;READ THE PORT IF NO CHAR IN MEMORY
5B58 79         MOV      A,C          ;PSEUDO-PORT
5B59 CD22C0     CALL    AINP
5B5C 77         MOV      M,A          ;STORE CHAR
5B5D C2665B     JNZ     CSKEY          ;CHAR RCVD
5B60 3680       MVI      M,80H        ;NO CHAR FLAG
5B62 AF         XRA      A          ;A=0 IF NO KEY
5B63 C3685B     JMP     CSEXIT        ;NO KEY
5B66 3EFF       CSKEY:  MVI      A,0FFH      ;A=0FFH IF KEY
                    ;FLAGS ARE SET
5B68 2AEC5B     CSEXIT: LHLD    SAVBC          ;RESTORE
5B6B 44         MOV      B,H          ;BC
5B6C 4D         MOV      C,L          ;AND
5B6D 2AEA5B     LHLD    SAVHL        ;HL REGS
5B70 C9         RET

;
;SCONIN:          ;CONSOLE INPUT DRIVER
5B71 3A0300     LDA      IOBYT
5B74 C37F5B     JMP     SOLIN

;
;SREADER:        ;READER INPUT
5B77 3A0300     LDA      IOBYT
5B7A 1F1F       RAR     RAR
5B7C C37F5B     JMP     SOLIN

;
;SOLIN:          ;GENERAL SOL INPUT
                    ;ACC HAS DEV SELECT
                    ;SAVE
5B7F E603       ANI      3
5B81 32E35B     STA      DEVSEL
5B84 CD405B     CALL    SOLST
5B87 3AE35B     LDA      DEVSEL
5B8A CA7F5B     JZ      SOLIN        ;UNTIL CHAR READY
5B8D 22EA5B     SHLD    SAVHL        ;SAVE HL REG
5B90 2AE45B     LHLD    PTCHAR
5B93 7E         MOV      A,M          ;GET CHAR
5B94 3680       MVI      M,80H        ;NO CHAR FLAG
5B96 2AEA5B     LHLD    SAVHL        ;RESTORE HL REG
5B99 E67F       ANI      7FH          ;STRIP PARITY
5B9B C9         RET

;
;SCONOUT:        ;CONSOLE OUTPUT DRIVER
5B9C 3A0300     LDA      IOBYT
5B9F C3B45B     JMP     SOLOUT

;
;SLIST:          ;LIST OUTPUT
5BA2 3A0300     LDA      IOBYT

```

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```

5BA5 0707          RLC ! RLC
5BA7 C3B45B       JMP      SOLOUT
;
SPUNCH:           ;PUNCH OUTPUT
5BAA 3A0300       LDA      IOBYT
5BAD 1F1F1F1F     RAR ! RAR ! RAR ! RAR
5BB1 C3B45B       JMP      SOLOUT
;
SOLOUT:           ;GENERAL SOL OUTPUT
                  ;ACC HAS DEVICE SELECT
                  ;STORE HL
5BB4 22EA5B       SHLD     SAVHL
5BB7 60           MOV      H,B
5BB8 69           MOV      L,C
5BB9 22EC5B       SHLD     SAVBC      ;AND BC
5BBC 41           MOV      B,C      ;SOLOS WANTS CHAR IN B
5BBD E603         ANI      3        ;DEV SELECT
5BBF C2D35B       JNZ      OUTSOL     ;NOT VIDEO
5BC2 3AE25B       LDA      LASTOUT  ;CHAR TO OUTPUT IN C
5BC5 FE0D         CPI      0DH     ;ASCII CARRIAGE RETURN
5BC7 C2CE5B       JNZ      OUTVID
5BCA B9           CMP      C        ;CHECK IF 2 X CR
                  ;DON'T OUTPUT TWO CARRIAGE RETURNS
5BCB CAD65B       JZ       OUTEXIT
OUTVID:
5BCE 79           MOV      A,C
5BCF 32E25B       STA      LASTOUT  ;SAVE IT
5BD2 AF           XRA      A        ;SET A=0 FOR VIDEO
OUTSOL:           ;SEND THE CHAR TO SOLOS
5BD3 CD1CC0       CALL     AOUT
OUTEXIT:          ;RESTORE REGS AND EXIT
                  ;PICK UP BC
5BD6 2AEC5B       LHLD     SAVBC
5BD9 44           MOV      B,H
5BDA 4D           MOV      C,L
5BDB 2AEA5B       LHLD     SAVHL     ;AND HL REGS
5BDE 79           MOV      A,C     ;SOME PROGS EXPECT CHAR
5BDF C9           RET
SPRSTAT:          ;PUT OUT TO RET IN ACC
                  ;PRINTER STATUS
5BE0 AFC9         XRA A ! RET
;
;*** DATA AREA ***
5BE2 00           LASTOUT:DB 0      ;STORES POSS CARRIGE RET
5BE3             DEVSEL: DS 1      ;TO SELECT PSEUDO-PORT
5BE4             PTCHAR: DS 2      ;POINTER TO CHAR 0-3
5BE6 00           CHAR0:  DB 0     ;LASTIN FROM PSEUDO-PORT 0
5BE7 00           CHAR1:  DB 0     ;LASTIN FROM 1
5BE8 00           CHAR2:  DB 0     ;LASTIN FROM 2
5BE9 00           CHAR3:  DB 0     ;LASTIN FROM 3
5BEA             SAVHL:  DS 2      ;SAVE HL REG
5BEC             SAVBC:  DS 2      ;SAVE BC REG
5BEE =           SOLLEN  EQU  $     ;LENGTH
;
;
;*****
;SPECIAL CONFIGURATION 82 -- TDL SMB MONITOR BOARD
;*****

```

```

;
0016 = MSIZE EQU 22 ;DECIMAL SIZE OF SYSTEM
5600 = BIOS EQU (MSIZE*1024)-200H ;STANDARD CP/M CONVENTION
5B00 = USER EQU BIOS+500H ;LOCATION TO USER AREA
C900 = OFFSET EQU 1F00H-BIOS ;TO SYSGEN IMAGE
;JUMPS MUST REMAIN HERE, IN SAME ORDER

5B00 ORG USER

SMB0: ;SMB USER AREA

5B00 C31D5B JMP SMBCINIT
5B03 C3335B JMP SMBST
5B06 C31E5B JMP SMBCI
5B09 C32A5B JMP SMBCO
5B0C C3305B JMP SMBLO
5B0F C32D5B JMP SMBPO
5B12 C3245B JMP SMBRI
5B15 C3365B JMP SMBPRST
5B18 000000 DB 0,0,0
5B1B 3800 DW SMLEN

SMBCINIT: ;INIT DONE BY SMB
5B1D C9 RET

SMBCI:
5B1E CD03F0 CALL 0F003H ;CI ENTRY IN SMB
5B21 E67F ANI 7FH
5B23 C9 RET
5B24 CD06F0 SMBRI: CALL 0F006H ;RI ENTRY IN SMB
5B27 E67F ANI 7FH
5B29 C9 RET
5B2A C309F0 SMBCO: JMP 0F009H ;CO ENTRY IN SMB
5B2D C30CF0 SMBPO: JMP 0F00CH ;PO ENTRY IN SMB
5B30 C30FF0 SMBLO: JMP 0F00FH ;LO ENTRY IN SMB
5B33 C312F0 SMBST: JMP 0F012H ;CSTS ENTRY IN SMB

SMBPRST:
5B36 AFC9 XRA A ! RET
0038 = SMLEN EQU $-SMB0
;
;
;*****
;SPECIAL CONFIGURATION 83 - NORTH STAR HORIZON
;*****
;
0016 = MSIZE EQU 22 ;DECIMAL SIZE OF SYSTEM
5600 = BIOS EQU (MSIZE*1024)-200H ;STANDARD CP/M CONVENTION
5B00 = USER EQU BIOS+500H ;LOCATION TO USER AREA
C900 = OFFSET EQU 1F00H-BIOS ;TO SYSGEN IMAGE
;JUMPS MUST REMAIN HERE, IN SAME ORDER

5B00 ORG USER

HOR0: ;BASE OF HORIZON USER AREA

5B00 C3A65B JMP HORCINIT
5B03 C31D5B JMP HORST
5B06 C33B5B JMP HORIN
5B09 C3735B JMP HOROUT
5B0C C3735B JMP HORLIST
5B0F C3735B JMP HORMPUNCH
5B12 C33B5B JMP HORREADER
5B15 000000 DB 0,0,0

```

CP/M on North Star Double Density Disk Users Notes

```

5B18 FC00          DW          HORLEN
5B1A 00          HORIOB: DB          0          ;IOBYTE FOR HORIZON
5B1B 00          PARFLG: DB          0          ;0=NO PAR, 1=PARITY
                                     ;SET ON MEMORY BOARD
5B1C E8          PROMLOC:DB          0E800H/256 AND OFFH      ;ADDR OF PROM
HORST:
5B1D 3A1A5B      LDA          HORIOB
5B20 E603        ANI          3          ;STRIP OUT CONSOLE
5B22 CA2B5B      JZ          HORST0
5B25 3D         DCR          A
5B26 CA335B      JZ          HORST1
5B29 AFC9        XRA A ! RET          ;ONLY 2 SERIAL PORTS
5B2B DB03        HORST0: IN          3
5B2D E602        ANI          2
5B2F C8         RZ          ;NO KEY
5B30 3EFFC9      MVI A,OFFH ! RET      ;KEY
5B33 DB05        HORST1: IN          5
5B35 E602        ANI          2
5B37 C8         RZ          ;NO KEY
5B38 3EFFC9      MVI A,OFFH ! RET      ;KEY
HORREADER:
HORIN:          ;HORIZON INPUT ROUTINE
5B3B 3A1A5B      LDA          HORIOB
5B3E E603        ANI          3
5B40 CA5B5B      JZ          HORIN0      ;1ST SERIAL PORT
5B43 3D         DCR          A
5B44 CA675B      JZ          HORIN1      ;2ND SERIAL PORT
5B47 3D         DCR          A
5B48 C0         RNZ          ;NO 4TH DEVICE
                                     ;FALL INTO PARALLEL ROUTINE
HORIN2:        ;PARALLEL PORT
5B49 DB06        IN          6          ;MOTHERBOARD STATUS
5B4B E602        ANI          2          ;MASK TO GET PI FLAG
5B4D CA495B      JZ          HORIN2
5B50 DB00        IN          0          ;READ KEYBOARD
5B52 F5         PUSH         PSW        ;SAVE CHAR
5B53 3E30        MVI          A,30H
5B55 D306        OUT          6          ;RESET PI FLAG
5B57 F1E67F      POP PSW ! ANI 7FH
5B5A C9         RET
5B5B DB03        HORIN0: IN          3          ;FIRST SERIAL PORT
5B5D E602        ANI          2
5B5F CA5B5B      JZ          HORIN0
5B62 DB02        IN          2
5B64 E67F        ANI          7FH
5B66 C9         RET
5B67 DB05        HORIN1: IN          5          ;SECOND SERIAL PORT
5B69 E602        ANI          2
5B6B CA675B      JZ          HORIN1
5B6E DB04        IN          4
5B70 E67F        ANI          7FH
5B72 C9         RET

```

```

;
HORLIST:
HORPUNCH:

```

```

HOROUT:                                ;HORIZON OUTPUT ROUTINE
5B73 3A1A5B    LDA    HORIOB
5B76 E603      ANI    3
5B78 CA905B    JZ     HOROUT0    ;1ST SERIAL PORT
5B7B 3D        DCR    A
5B7C CA9B5B    JZ     HOROUT1    ;2ND SERIAL PORT
5B7F 3D        DCR    A
5B80 C0        RNZ
                                ;ONLY 3 PORTS
                                ;FALL INTO PARALLEL OUTPUT ROUTINE
HOROUT2:                                ;PARALLEL OUTPUT
5B81 DB06      IN     6
5B83 E601      ANI    1
5B85 CA815B    JZ     HOROUT2
5B88 79        MOV    A,C
5B89 D300      OUT    0
5B8B 3E20      MVI    A,20H
5B8D D306      OUT    6
5B8F C9        RET
                                ;MOTHERBOARD STATUS
                                ;MASK TO GET PO FLAG
                                ;RESET PO FLAG
HOROUT0:                                ;1ST SERIAL PORT
5B90 DB03      IN     3
5B92 E601      ANI    1
5B94 CA9B5B    JZ     HOROUT1
5B97 79        MOV    A,C
5B98 D302      OUT    2
5B9A C9        RET
HOROUT1:                                ;2ND SERIAL PORT
5B9B DB05      IN     5
5B9D E601      ANI    1
5B9F CA9B5B    JZ     HOROUT1
5BA2 79        MOV    A,C
5BA3 D304      OUT    4
5BA5 C9        RET
;
;HORCINIT:
5BA6 3EFE      MVI    A,0FEH
5BA8 D3C0      OUT    0C0H    ;DISARM PARITY
5BAA 3A1B5B    LDA    PARFLG
5BAD B7        ORA    A
5BAE CADA5B    JZ     NOPAR
;
;SPECIAL INIT ROUTINE FOR HORIZON
;COME HERE IF YOU USE THE PARITY OPTION
;
5BB1 210000    TINIT:  LXI    H,0
5BB4 3A1C5B    LDA    PROMLOC
5BB7 57        MOV    D,A
5BB8 7C        TINKL:  MOV    A,H
5BB9 BA        CMP    D
5BBA C2C35B    JNZ    TINCP
5BBD C604      ADI    4
5BBF 67        MOV    H,A
5BC0 CAD65B    JZ     TINU
5BC3 7E        TINCP:  MOV    A,M
5BC4 77        MOV    M,A
5BC5 2C        INR    L
;READ ALL MEMORY
;PUT BACK WITH PARITY SET

```



```

5B12 C3255B      JMP      VECREADER
5B15 C3475B      JMP      VECPRST
5B18 000000      DB      0,0,0
5B1B 4A00        DW      VECLEN

VECST:           ;CONSOLE STATUS
                 ;LOOK FOR CHAR
5B1D CD315B      CALL     VECSTAT
5B20 3E00        MVI     A,0
5B22 C8          RZ      ;NO KEY, EXIT
5B23 2F          CMA     ;IF KEY
5B24 C9          RET     ;EXIT

VECREADER:
VECIN:           ;CONSOLE INPUT
                 ;SEE IF CHAR READY
5B25 CD315B      CALL     VECSTAT
5B28 CA255B      JZ      VECIN
                 ;LOOP UNTIL CHAR
5B2B 7E          MOV     A,M
                 ;CHAR STORED BY VECSTAT
5B2C 3600        MVI     M,0
                 ;TELL STAT RTN WE HAVE CHAR
5B2E E67F        ANI     7FH
                 ;STRIP PARITY
5B30 C9          RET     ;EXIT

VECSTAT:
5B31 21495B      LXI     H,VCHAR
                 ;POINT TO STORAGE
5B34 34          INR     M
                 ;THIS IS 0 IF
5B35 35          DCR     M
                 ;NO CHAR THERE PREV
5B36 C0          RNZ
                 ;RET IF CHAR ALREADY THERE
5B37 CDDCC0      CALL     CNTLC
                 ;PROM INPUT RTN
5B3A 77          MOV     M,A
                 ;STORE CHAR
5B3B B7          ORA     A
                 ;FLAG
5B3C C9          RET

VECLIST:
VECPUNCH:
VECOUT:          ;OUTPUT ROUTINE
                 ;PROM WANTS CHAR IN ACC
5B3D 79          MOV     A,C
                 ;PROM OUTPUT RTN
5B3E CD98C0      CALL     PTLOP
                 ;EXIT
5B41 C9          RET     ;COLD INIT

VECCINIT:
5B42 AF          XRA     A
5B43 32495B      STA     VCHAR
                 ;WARM INIT
5B46 C9          RET

VECPRST:
5B47 AFC9        XRA     A ! RET
                 ;PRINTER STATUS
5B49 00          VCHAR: DB      0
                 ;STORE CHAR FROM VECSTAT
004A =          VECLEN EQU    $-VECO
;
;

```

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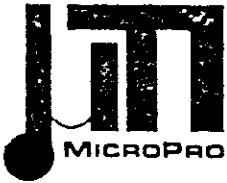
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CP/M on North Star Disk - Double Density Version

Errata in Users Notes Rev 1.0 dated 2/24/79

- 1) In section VI, paragraph 3, the third and fourth sentences should read:

Just give the command "FORMAT CR" and the program will ask you which drive to use and whether to format in single or double density. The disk is ready to use after FORMAT runs.

- 2) The section on page 12 titled 'Using Existing Single Density User Area' is in error and should not be followed. Any owner of a single density system should use their editor and assembler to create a suitable USER area. This may be the same as used in the single density system, but must be specially ORGed at 5B00H.

If this is prepared, the procedure to place it in the second half of sector 17 on the Double Density disk may be followed.

- 3) In the last paragraph on page 17, the command:

```
SAVE 36 CPM24.COM
```

should be:

```
SAVE 36 CPM22.COM
```

- 4) Two data lines in the listing Appendix are incorrect. In configuration number 3 the line:

```
0,0,0,1,1,20H,20H,20H,20H,2,2
```

should be:

```
0,1,1,20H,20H,2,2 for TTS,TTI,TTO,RDA,RDAMSK,TBE,TBEMSK
```

In configuration number 4, the line:

```
0,0,0,1,1,40H,40H,40H,40H,80H,80H
```

should be:

```
0,1,1,40H,40H,80H,80H for TTS,TTI,TTO,RDA,RDAMSK,TBE,TBEMSK
```

- 5) The Horizon configuration has been slightly altered. The disk file GENUSER.ASM has the correct code as used in the system for configurations 3 and 4 as described above and the revised Horizon routines.

Additional Notes on Double Density  
CP/M on North Star

Based on enquiries, the following additional notes are offered to users of Double Density CP/M on North Star:

- 1) A diskette must be formatted using the FORMAT program before it can be used with CP/M. The one exception is that the COPY program will format a new or damaged disk. If you wish to take advantage of this feature, you must copy ALL the diskette tracks to prevent some remaining unformatted.
- 2) Certain software products of Lifeboat Associates may be shipped to double density users on single density format. If the label does not explicitly state double density format, use the DENSITY program to set drive B to single density and use PIP to copy the files to the double density diskette on drive A.
- 3) After running the MOVCPM program and SYSGENing the enlarged system onto a disk, the new system is unconfigured. It is necessary to cold boot such a system the first time with the program CONFIG.COM on the diskette. Patching the byte at 120H to the correct configuration number and executing at 100H will cause the system to sign-on and then SAVEUSER may fix the patched USER area onto the diskette. The DOS method suggested for initial system start-up is only intended to be used on the 22K system as distributed.
- 4) The CONFIG.COM program can be permanently configured by patching the byte at 120H to the configuration number and re-saving the file on the disk. If this is done, cold booting a newly created system will cause CONFIG to immediately execute the correct sequence.
- 5) In the event that a highly non-standard USER section is required and no monitor is available, the DOS method will work for the first time around. For other system sizes the USER, correctly assembled for the new size, may be inserted in CONFIG at 200H. If the entry of CONFIG at 100H is patched to a jump to 109H, CONFIG will move the USER routines to the correct location in BIOS, ready for the SAVEUSER execution.
- 6) A summary of CONFIG.COM entry points:
  - 100H Jump to 103H if the value at 120H is 0FFH. If 120H has a configuration number, then move the appropriate USER routines to the USER address in BIOS and sign-on.
  - 103H Jump to 103H. This is a "soft" halt and may be modified to re-enter a monitor, such as DDT at 38H or Zapple at 0F000H.
  - 106H Move the configured USER appropriate to the value set at 120H to memory starting at 200H and then jump to 103H.
  - 109H Move the routines in memory at 200H to the USER address in BIOS and then jump to sign-on.

Additional Notes on Double Density  
CP/M on North Star

Based on a number of enquiries from users of the Double Density CP/M system, these notes are intended to present two procedures in a fuller dialog format. The first is a modification of the system initiation procedure suggested in the Users Notes which employs the feature that CONFIG will not soft halt but run to conclusion when the value byte has been pre-set to a valid configuration number. This is offered so that the system relocation procedure (PROCEDURE II) may be treated in a similar manner using the pre-setting of CONFIG from the first earlier session.

The second procedure is used to relocate the CP/M system to make use of a different (usually larger) memory size than the distribution system utilization of 24K of R/W memory.

PROCEDURE I. Bringing up CP/M by patching the CONFIG.COM program

Step 1. Boot in NORTHSTAR DOS in the usual way.

2. Insert copy (NEVER ORIGINAL) of CP/M diskette into drive A.

3. Type command: GO CPM (cr).

You should get the normal sign-on message:

CP/M on North Star double density disk

22K Version 1.44

Copyright (C) 1979 Lifeboat Associates

A>

4. Type command: DDT CONFIG.COM (cr). The system will respond with:

DDT VERS 1.4 .

NEXT PC

0B00 0100

5. Type: S120 (cr). The system will respond with:

0120 FF

6. Type the hex byte for your system (e.g. ah 83 for a HORIZON) followed by a (cr). The system will respond with a

0121 A0

7. Type: . (period) followed by a (cr). At this point we could simply type G100 to execute the configurator. Instead we will save the patched configurator so that it can also be used in Procedure II below for system relocation.

8. Type: ^C (control C). The system will return to the A> prompt.

9. Type: SAVE 10 CONFIG.COM (cr). Note that the 10 was from the 0B00 message of DDT. It refers to the 10 decimal pages occupied by CONFIG.COM between 100H and B00H in memory.

The system configurator program, CONFIG.COM, has now been modified to preset to the desired configuration.

10. Now COLD boot the system. You should get the message:

CONFIG Version 1.5

Copyright (C) 1979 Lifeboat Associates

Your CP/M system is now configured.

Type SAVEUSER to permanently save on disk.

A>

11. Type: SAVEUSER (cr). The program will prompt you to finish the procedure by typing a (cr) to patch the system tracks on disk.

## PROCEDURE II. System relocation.

As supplied, the CP/M system uses 24K of R/W memory starting at address 0. This is not sufficient to use the majority of the languages and applications software available. Attempts to run programs too large for the memory will result in a LOAD ERROR message. To utilize more memory it is necessary to employ the MOVCPM system relocation utility.

- Step 1. Copy the configured diskette from Procedure I. (NOTE: This procedure depends upon having a modified version of CONFIG.COM which is prepared as in steps 4 through 9 of Procedure I).
2. Place the copy in drive A and cold boot.
3. Type command: MOVCPM xx (cr) (xx is number of K two less than the amount of memory you wish to use. Type MOVCPM \* to use all available memory). The system will report the system size being generated and end by inviting the use of SYSGEN or the saving of the system image as a file.
4. Type command: SYSGEN (cr). The SYSGEN program will sign-on:  
SYSGEN VER 1.1  
FOR NORTH STAR DD CP/M

SOURCE DRIVE (OR RETURN TO SKIP)

Type a (cr) since the system is in memory and not to be fetched from the system tracks of a diskette. The program will continue:

DESTINATION DRIVE NAME (OR RETURN TO REBOOT)

Type: A signifying drive A is to receive the system. SYSGEN will continue with the prompt:

DESTINATION ON A, THEN TYPE RETURN

The desired diskette is already mounted in drive A so simply hit the (cr). SYSGEN will offer another opportunity to write the system with:

FUNCTION COMPLETE  
DESINATION DRIVE NAME (OR RETURN TO REBOOT)

At this point do NOT type a return, since a warm boot which would follow would fail, as the system in residence (22K) is now different from the system on the diskette. Perform a COLD boot. The system will announce the message:

CONFIG Version 1.5  
Copyright (C) 1979 Lifeboat Associates  
Your CP/M System is now configured.  
Type SAVEUSER to permanently save on disk.

A>

5. Type command: SAVEUSER. The program will prompt you to type a (cr) to patch the configuration onto the disk system tracks.

A trial cold boot now will cause a system to sign on with the the correct new system size in the message.