CP/M ON MICROPOLIS

USERS' NOTES

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Revision 1.01
May 15. 1978

INTRODUCTION TO THE NOTES

This set of CP/M on Micropolis Users' Notes is intended as supplementary material to the Digital Research manuals which accompany the system.

It is not intended to serve as a stand-alone guide to CP/M, but is aimed at assisting the new system owner in bringing CP/M on Micropolis up on their own equipment as swiftly as practicable. It is also aimed at informing the more experienced users about certain of the internal "hooks" available for more unusual tasks, such as formatting disks, using mixed Mod I and Mod II disk drives, expanding the directory capacity, etc.

We do warn the new user that because of the lack of any accepted convention for attaching a console terminal to an 8080/Z80 system, some care is necessary in following the instructions on configuration.

The Users' Notes are presented in the following sections:

STARTING OUT

On receiving your CP/M on Micropolis 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 Micropolis is a serial numbered system licensed for your use. 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 advanced piece of technical equipment which is under constant review and improvement both at Lifeboat Associates and at 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, read, at the minimum, the Digital Research manual "An Introduction to CP/M Features and Facilities" in addition to this "CP/M on Micropolis User' Notes". Thorough reading of these will make the process of bringing up the system far smoother. For further details, the user should also refer to the manuals "CP/M Interface Guide" and "CP/M System Alteration Guide".

Using the facilities of Micropolis BASIC or PDS systems, initialize a blank diskette and make a copy of the distribution CP/M on Micropolis diskette. We recommend that you write-protect the distribution diskette immediately after you receive it and make a rule NEVER to write to it. It will provide a last resort back-up, regardless of what happens later, in the event of hardware or software malfunction.

CONFIGURING FOR A STANDARD TERMINAL

The CP/M on Micropolis includes, with permission of Micropolis Corporation, the Configurator program used to bring up Micropolis BASIC and PDS. We have implemented it here with as few differences as possible, in order that its operation will be much as the users have already completed successfully before.

The Standard terminal configurations are the same as listed in the Micropolis manuals, with the addition of the TDL SMB/Zapple configuration. The numbers are the HEX values of the sense switches set to initialize to that configuration or the value deposited in memory, as described below in step 4 of this section:

0) Altair 88-2SIO
1) IMSAI SIO2
2) Altair SIO (Rev Non-Zero)

3) Altair SIO (Rev Zero)
4) PTC 3P+S
5) IMSAI MIO
6) Altair 88-4PIO
80) COMPAL 80
81) PTC SOL
82) TDL SMB (Zapple)

Refer to the Micropolis manual for full specification of the port numbers, masks for TBE and RDA, and the sense of the status, whether active high or active low.

If your terminal interface uses one of the configurations listed on the table, then the configuration process is very straight forward:

1) Place a copy of the distribution diskette into your drive. In a multi-drive system, select the drive addressed as Drive 0, in the Micropolis convention. The diskette should be your duplicated copy of the original diskette and it should not be write-protected.

2) Using a front-panel, or whatever other facilities are available, start execution of the cold boot prom on the Micropolis controller card. The cold boot action should be identical to that used to bring up the Micropolis software and will operate with the new relocatable proms and the earlier versions limited to operate at F400H. After the prom program has been started, there should be an audible click from the head load, and the Select LED of drive 0 (called drive A in CP/M convention) will be illuminated. After a few seconds of loading, with visible activity of front panel lights for those computers with this feature, the drive will de-select and the front panel activity will cease. If there was no head selection, check your hardware and also the correct address of the cold boot prom. If the load did not appear to be clean, with symptoms of multiple head snapping sounds or failure to stop with an idle front panel, then follow the procedure for Unrecoverable Disk Error, found below.

3) Using front panel switches or other facilities, examine memory location 4CFH for a report on the load. As in the Micropolis convention, the contents of the location may be:

47H (ASCII "G") - Good Load

55H (ASCII "U") - Unrecoverable Disk Error

4DH (ASCII "M") - Bad Memory

In the event that a "U" Error Type is encountered, re-seat the diskette and try again. If again unsuccessful, make a fresh copy of the distribution diskette and use that. Repeated failure suggests either a hardware malfunction or that a faulty diskette is in use.

If an "M" Error Type is found, examine memory location 4CDH. The address of the memory at which the error occurred is

preserved in standard SHLD form (i.e. Low Address, High Address) in 4CDH and 4CEH. Use whatever tools are available to thoroughly test the memory required by CP/M - i.e. continuous unprotected RAM between 0 and 5FFFH in the distribution system. In a later section, the relocation of CP/M to larger and smaller system sizes will be explained.

4) After achieving a Good Load report, the system is ready to be patched to the Standard configuration number. As in the Micropolis procedure for PDS, this may be done either with the front panel sense switches or by depositing the configuration number into a memory location.

In Altair/Imsai front panel systems, set the address switches to 4D1H, and examine. Set the sense switches to the configuration number desired, and press run. (Incidentally, it should be mentioned that SOL and Zitan owners have sense switches available for this procédure, albeit not mounted on the front panel. Check the equipment manuals for details.)

In systems without sense switches (a parallel input addressed as Port FFH), the procedure is to enter the desired configuration number into memory location 4D0H using whatever monitor program is available and start program execution at location 4D6H.

Once started, the Configurator program will build terminal I/O drivers to match the chosen configuration, and the system will sign-on with a message:

```
CP/M ON MICROPOLIS
22K VERSION 1.41
COPYRIGHT (C) 1978 LIFEBOAT ASSOCIATES

A>
```

or as revised for a later version or non-standard size system. After the system has signed-on, proceed to the section of the Users' Notes titled Saving Configured Systems.

CONFIGURING FOR A NON-STANDARD TERMINAL

If the terminal I/O configuration is not precisely as one of the standard versions offered, it will be necessary to patch the correct routines into memory in the locations that CP/M expects them.

Appendix A gives an example of a typical User area of memory, the name we have given to the 200H region reserved for I/O drivers for the user's Console, List, Punch and Reader devices. It must be stressed that it is not essential that four separate peripheral devices are present. These are "Logical" not "Physical" devices. For example, a typical system may use a Teletype for both console and punch output devices. CP/M will treat these as distinct devices, expanding tabs for console output, and sending a 9 (Ctl I) ASCII character in the output addressed to the punch.

The file listed in the Appendix A example is actually supplied on your diskette as USER.ASM. and this is available for modification as described in the section on System Relocation. In reviewing the listing, recognize the essential features:

1) The code begins with 8 jumps. These locations relative to MSIZE must not be altered, as the system assumes these locations. The destination addresses will conform with whatever routines are entered to service these jumps.

2) The convention for the last 6 routines are fully defined in the Digital Research manual "CP/M System Alteration Guide", pages 17 through 19. For instance, output routines arrive with characters carried in the C register, and input routines return with the character in the A register and with the high order bit zero. The console status returns an FFH for a true Received Data Available, and 0 for none.

3) The initialization routines, CINIT and WINIT are called only during either cold boot or warm boot, respectively. In the CINIT, we recommend that as a minimum the IOBYTE, address 3, be set to 0 or 1. This is recommended to avoid a value randomly occurring with the two low bits equal to 2. Otherwise in error recovery, CP/M will recognize that the IOBYTE, as explained on pages 15 and 16 of the CP/M Systems Alteration Guide, defines a system in batch mode, and will not permit a <CR> to command a re-try. CINIT and WINIT are available to program USARTS, left-margin a printer, read a hardware clock or calendar, and perform any other house-keeping chore the system requires.

It is first necessary to decide whether any of the Standard configurations offer anything, so that modifying them is advantageous over starting from scratch. If it is preferred to move a Standard driver into the User area, perform the procedures described for that Standard driver, using steps 1 through 4 of the section Configuring for a Standard Terminal, with the exception that the configuration numbers are altered by adding 40H. Adding 40H notifies the Configurator program that the routines are to be moved to the User area, but that the system should not then be given control to sign-on. Thus the configuration values to set up on sense switches or entered into memory location 4D0H are:

40) Altair 88-2SIO
41) IMSAI SIO2
42) Altair SIO (Rev Non-Zero)
43) Altair SIO (Rev Zero)
44) PTC 3P+S
45) IMSAI MIO
46) Altair 88-4PIO
C0) COMPAL 80
C1) PTC SOL
C2) TDL SMB (Zapple)

After starting the program to run at 4D1H or 4D6H, depending upon whether front panel switches are used, the processor is again stopped. Examination of the User area, which lies between 5C00H and 5DFFH in the distribution 22K nominal system, will reveal the

routines moved in. Using either front panel switches or a system monitor program, make whatever alterations are required. Perhaps the user's port addresses on their 3P+S were strapped for values other than 0 and 1. for example, and these revised values can now be entered to replace the values entered by the Configurator into the prototype skeleton.

When the alteration of a Standard configuration has been completed, or a completely new one created, the computer is restarted, but this time with a configuration number of F0 as the hex value on the sense switches for a start at 4D1h or in memory address 4D0H for the start at 4D6H. Configuration F0 starts the system log-on without altering the User area of memory.

If successful in correctly patching console routines to service the needs of the system, the sign-on message will be given. Proceed next to the section on Saving Configured Systems.

SAVING CONFIGURED SYSTEMS

After successfully patching the system to log-on, briefly check out some of the functions. By typing "DIR" (the quotes should NOT be typed) a list of files on the logged-in diskette will be displayed. Try again typing "DIR", and then striking any keyboard character before the list is completed. The listing should be interrupted, and the system returned to the "A>" prompt message. Typing "STAT *.*" will give more details about the files, including the size of each and the unused space remaining on the diskette. A final test is to type "SAVE 1 TEST", which will check that the diskette is writing successfully and is not write-protected. A further "DIR" will show the addition of the file TEST which was created. This can be cleaned up by typing "ERA TEST".

If the above tests indicate that a normally functioning system is achieved, type the command "SAVEUSER". This program will permanently write the configuration onto the diskette, so that the system will in future cold boot from the diskette fully configured. Remember that this should only be performed onto a duplicate of the distribution diskette, never onto the original. Note that SAVEUSER only saves the User region of memory onto the appropriate sectors of the diskette, it does not create a whole system on the diskette, and so a copy of the original CP/M on Micropolis distribution diskette must be in drive A (Micropolis 0) for the save to be effective.

SYSTEM RELOCATION

The CP/M system is relocatable in memory. The CCP, BDOS and BIOS sub-systems can be loaded in memory as a group at any 1K boundary for nominal system sizes of between 18K (requiring 20K of memory) and 62K (requiring 64K of memory). This permits the user to select the size of system for efficient operation of the programs required, without requiring unnecessay amounts of memory, and permits areas of memory to be dedicated to other tasks. CP/M systems of all sizes require the same addresses in page zero of memory. Note that CP/M

on Micropolis uses no memory locations in the 40H region permitted for scratch BOOT and BIOS storage. Refer to page 21 of the Digital Research manual "CP/M System Alteration Guide" for a table of reserved locations in page zero of memory.

The utilities provided to relocate the system are MOVECPM.COM and SYSGEN.COM. Both programs are described in the manual "An Introduction To CP/M Features And Facilities". The notes here are given only to supplement the Digital Research documemtation in terms of special features in the CP/M on Micropolis implementation.

Running the MOVECPM.COM program in its original form will create a system, of chosen size, in the unconfigured style in which the distribution system of 22K arrived. Simply SYSGENing the system onto a diskette and then using the configuration procedure described before is a direct and workable method of patching the terminal I/O.

A sample session to change to a 30K nominal system would be:

O[perator]
P[rograms]

```
O       MOVECPM 30 *

P       CONSTRUCTING 30 K CP/M ON MICROPOLIS
P                 VERSION 1.41

P       SYSTEM REQUIRES 32K OF MEMORY
P       READY FOR "SYSGEN" OR
P       "SAVE 40 CPM30.COM"

O       SYSGEN

P       MICROPOLIS SYSGEN VER 1.4
P       SOURCE DRIVE NAME (OR RETURN TO SKIP)

O       <RETURN>

P       DESTINATION DRIVE NAME (OR RETURN TO REBOOT)

O       A (OPTIONAL)

P       FUNCTION COMPLETE
P       DESTINATION DRIVE NAME (OR RETURN TO REBOOT)
```

Note that a return after the above sequence must NOT be typed, since the system would attempt to perform a warm boot from a disk with a system of different size from the system in RAM.

The correct sequence is to perform a COLD boot, and then to configure the system exactly as the original distribution system was brought up.

After configuring the console and having the newly configured system sign-on, use the SAVEUSER program to fix the patched User area onto the diskette. The SAVEUSER program will correctly save the console patches in any sized system. The key addresses used in the

Configurator program are constant for all system sizes, except that if manual patching of the USER area is necessary, the USER area must be located for each sized system. Simply add 400H to the 5C00H of the 22K distribution system for each additional 1K greater than 22K.

The source of the example USER area is supplied as disk file USER.ASM, and is available for editing to different drivers and different memory sizes.

A special feature of the MOVECPM.COM which may be of value to those using Standard configurations is that a simple patch can be made which will cause the systems created to self-configure themselves. The method of patching the MOVECPM.COM program is to load it into memory using DDT. Using the D command, you will see that the byte at 26FF is set to FFH, which signifies an unconfigured system. Set this byte to the hex value of the desired configuration number, e.g. a 2 for MITS SIO Rev Non-Zero, and re-save the program, perhaps using a different name in order to make the alteration plainer.

Running this modified program will create systems which are pre-configured and will cold-boot, without a soft halt, directly to sign-on.

The traditional method of relocating CP/M is to assemble a USER area with the origin address set for the correct memory size (e.g. 5C00H for a 22K system) and then to insert it into the relocated system in MOVECPM/SYSGEN image form using DDT with the correct offset (e.g. 2500H-5C00H=C900H). This procedure is fully described in the Digital Research manuals. Remember that the USER area is 600H above the BIOS used in their example calculations. Use the USER.ASM file supplied as a starting point and edit it for needed changes.

SYSTEM LAYOUT

The purpose of this section is to describe the location of the CP/M on Micropolis system as it resides in memory during operation, in SYSGEN and on the diskette system tracks. The reader should refer to the Digital Research manual "CP/M Interface Guide" for information on the functions of the CP/M components and their normal organization in memory. This note will assume familiarity with the manuals, and will not attempt to explain the functions of the CP/M component sub-systems.

System Location in Memory

As the reader of the Digital Research manuals will see, the minimum resident portion of CP/M is the module called FDOS, which in turn consists of the two modules BDOS and BIOS. In CP/M on Micropolis, the unit BIOS is divided into the disk drivers and buffers on one side and the User area, used to hold the drivers of the console, list, reader and punch devices on the other. The user of CP/M on Micropolis will only need to be familiar with the structure of the User area in order to customize and alter peripheral device drivers, since the disk drivers are supplied fully configured. If the user wishes to make use of the BIOS for special purposes, the entry

points described in Section 6, page 14 of the "CP/M System Alteration Guide" are present and in the locations mentioned. Indeed it is for the reason of making these jump addresses accurate that the CP/M on Micropolis uses the term Nominal System Size. The nominal size refers to the system described in the Digital Research literature with identical entry points. Because of the buffer and disk driver size, the memory requirements of CP/M on Micropolis are actually 2K greater than the Nominal System Size. Thus, the distribution system of 22K requires 24K of RAM, starting at 0 for operation.

The following table is presented to give the addresses of the system in use and in SYSGEN form. The system generated by RELOC will be identical to the SYSGEN with respect to the memory regions occupied by sections of the system:

Module	22K System	SYSGEN	# of Disk Sectors
BOOT	N/A	900H	1
CCP	4100H	A00H	8
BDOS	4900H	1200H	13
BIOS	5600H	1F00H	6
USER	5C00H	2500H	2

System and Data Layout on Diskette

The arrangement of recording the data onto the diskettes is a skewed sequence, with each CP/M Group of sectors as defined in the file directories equal to 2K of data, or 8 sectors of the diskette. The CP/M system itself occupies tracks 0 and 1, the directory track 2 and the data space tracks 3 through 76 for Mod II and through track 34 for Mod I systems.

The skip factor in the skewing is 5, which was chosen as the fastest sequence to write data with the Read Before Write option active. The CP/M sector Groups 0 and 1 are reserved for the directory, and can permit up to 128 entries, where one entry corresponds to a file extent of up to 16K or eight Groups. Thus a file of 50K will use the same directory space as three files each less than 16K in length. The standard distribution system actually uses only Group 0 for directory entries, reserving group 1 for use if desired. Thus, only 64 entries can be recorded, unless the system is modified as detailed in the later section Other Technical Notes.

As an example of how the files are assigned to sectors, note that the sectors allocated to Groups 2 and 3 on track 3 are in the following sequence:

Group 2	0,5,10,15,4,9,14,3
Group 3	8,13,2,7,12,1,6,11

in the Micropolis convention of numbering 0 through 15, which corresponds to the skip of 5. The sequence repeats, with Group 4 starting with sectors 1 and 6 on track 4.

The data on the system tracks is laid down with a skip of 3 in order that the warm boot speed is adequate. Thus the sequence of data on tracks 0 and 1 is:

0,3,6,9,12,15,2,5,8,11,14,1,4,7,10,13

with track 1 repeating the sequence after track 0 is read or written. The sequence of the data is precisely as in the SYSGEN column of the table above. The BOOT occupies track 0 sector 1, CCP starts on sector 4. The USER area of BIOS is on sectors 5 and 8 of track 1, etc.

OTHER TECHNICAL NOTES

The disk drivers supplied with CP/M on Micropolis are designed to permit a great deal of flexibility to the user. The areas of freedom which may be controlled are:

- o Pre-Write Read
- o Read After Write
- o Write Protect Detect
- o Enable Interrupts after Disk Access
- o Run Auto after a Warm Boot
- o Run Auto after a Cold Boot

The choice of functions is controlled by the state of the bits in one byte referred to as the Mode Byte. The Mode Byte is locatable at the address immediately before the USER Area (the section reserved for the drivers of the console, list, reader and punch). The address of the byte in general is calculated as:

MSIZE + 400H - 1

where as explained before in the System Layout section, MSIZE is the nominal size of the CP/M system, as referenced in Digital Research literature, and so one requires MSIZE + 2K for use with CP/M on Micropolis. In particular, with the distribution system, having a nominal size of 22K. MSIZE is 5800H and the address of the Mode Byte is 5BFFH. In all cases, the address of the warm boot jump located at 0 is MSIZE - 200H + 3, or 5603H in the case of the distribution 22K system. Thus a program may simply reference the address and calculate the appropriate offset of 5BFFH - 5603H or 5FCH to read or manipulate the Mode Byte. A typical piece of code to perform this might be:

```
LHLD    1       ; Get Warm Boot Address into HL
LXI     B,5FCH  ; Use BC for the double add
DAD     B       ; Double Add to put address of
                ; Mode Byte into HL
MOV     A,M     ; Fetch 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 controlled function, and the default value used in distribution systems.

Pre-Write Read

The Pre-Write Read forces the disk drivers to read the sector physically preceding and on the same track as each sector to be written. This is intended to ensure that the position of the disk head is precisely as intended, by making use of the fact that any seek error would cause the sector format address to produce a read error and force the drive to re-seek. Because of the skew factor chosen for CP/M on Micropolis, use of this feature will cause no added delays in operation of the system. The availability of this bit will enable the user to write diskette formatting programs and to create any other special utility needed to write to an un-formatted diskette.

The position of this bit is the most significant position, i.e. with a value of 80H. The distribution system is shipped with the bit set HIGH and thus the feature is active. Micropolis Corporation recommend that this feature be used in normal operations.

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 read-back data matches the data in the write buffer. Use of this feature will cause no degredation in the speed of reading, but will slow writing by a factor of up to three times, since only one sector will be written per disk revolution, versus the three which could be written without verification.

The position of this bit is value 40H. The distribution system is shipped with the bit set HIGH and thus this feature is active. Micropolis Corporation recommend that this feature be used in all operations.

Write-Protect Detect

This feature permits the CP/M to detect whether a diskette to which writing is being attempted is protected with a write protect tab. and will signal a write error to the user. This feature is made optional because of a characteristic of CP/M which causes it to make token writes while reading large files. This is associated with closing the extent directory entries before moving to the next extent. (The extents each give directory information for up to 16K of a file.) The associated error message can be ignored and reading resumed by hitting a <CR> on the console. This is sometimes an inconvenience when equipment is running unattended. In any event, CP/M has built-in facilities to detect that a unsuccessful attempt has been made to write a file to a write-protected diskette, and the hardware detection feature is of no additional value.

The position of this bit is value 20H. The distribution system is shipped with the bit set LOW and thus this feature is not active.

Enable Interrupts after Disk Access

The drivers of the system disable interrupts during disk accesses, since the code is real-time dependent, having to service each bit recovered from or offered to the diskette. The 8080. 8085 and Z80 microprocessors do not have instructions to read the status of the interrupt flag, hence the status can not be restored to its original condition. The feature permits the user, either in general or under program control, to exit from disk accesses with interrupts enabled or disabled.

The position of this bit is value 10H. The distribution system is shipped with the bit set HIGH and thus the feature is active. (I.E. interrupts enabled on exit from a disk access).

Run Auto after a Warm Boot

Version 1.4 of CP/M includes a feature to execute a command on a start-up. This has application in loading monitors into memory, initializing peripheral drivers, or causing the system to enter an applications program for unskilled users. The CP/M on Micropolis has the command:

AUTO

set into it. This will cause an available 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. to take advantage of this feature. The Warm Boot Auto feature, as its name implies, causes the command to be invoked on each warm boot.

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

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 value 1. The distribution system is shipped with the bit set LOW and thus the feature is not active.

Other Parameters - Trackmax, Directory Size and DADR

Among other parameters that are under the control of the user, but not defined within the Mode Byte are the Diskette Size (Trackmax) values known both by the CP/M system and by the disk drivers, and the directory size (offered as a Directory Expansion Option). These addresses are made known to the user for completeness of documentation, but with the note of caution that these parameters should only be altered with care. It is possible to damage a disk drive through inadvertently driving it beyond the normal limit of travel. Also DADR, the address which holds the location of the disk drivers, is defined, permitting program access to both the drivers

themselves and also the cold boot prom 200H lower.

Trackmax

CP/M itself has only one value for the sizes of all four possible drives. The value is actually the number of 2K groups of data, including the directory, less one. For a MOD I system, the value is 65 (41H), and for MOD II it is 149 (95H). The address of this value is BDOS+3EH. In a 22K system. the address is 493EH. and in a SYSGEN image, the address is 123EH.

The disk drivers offer separate values for each drive in the system. This permits easy daisy chaining of MOD I and MOD II drives. with the ability to protect against damage to the MOD I units through selection of inaccessable track numbers. The addresses for drives A through D are BIOS+5FAH through BIOS+5FDH, and have values of 34 (22H) for MOD I drives and 76 (4CH) for MOD II. The address in a 22K system would be 5BFAH, and in a SYSGEN image. 24FAH.

Directory Expansion Option

The system configuration permits the allocation of all of track 2 to directory space. This permits 128 entries of files or extents, as explained in the earlier section on System Layout. The ability to have a large number of modest sized files (average less than 4.5K) is very useful in word-processing and in schemes using linking, but without library facilities, such as ML80. The penalty is that warm boots and erasures are slightly slower. Measurements suggest an extra half second per boot with the 128 entry directory. The systems are compatible in that a 128 directory entry system will read a 64 entry directory disk without error. The converse is that the 64 entry system will only search the first half of a 128 entry system. It is recommended that for software interchange purposes, 64 entry diskettes be exchanged, and that use of 128 directory diskettes be confined to internal use in the situations that benefit from this feature.

One minor note of warning is that the check to detect a changed diskette and write-protect it before a boot is only performed on the details of the first 64 entries. Thus, in the unlikely event that a system has two diskettes with identical details in the first 64 positions, the operator must bear in mind that interchanging between those diskettes will not cause write-protect.

The location of the parameter controlling the directory size is BDOS+3BH. which is 493BH in a 22K system, and at 123BH in a SYSGEN image. The values are 63 (3FH) for a 64 entry directory, and 127 (7F) for a 128 entry directory.

DADR

The address of the disk controller, which is normally shipped set to F400H, but can be altered with jumpers, is stored at a location known in the Micropolis terminology as DADR (Disk ADdRess). This storage address is located at BIOS+800H, which is 2700H in SYSGEN

form and 5E00H in the distribution nominal 22K system. By picking up the address from DADR, programs have access to the Micropolis controller and boot prom directly, regardless where they have been addressed.

APPENDIX A - SAMPLE USER AREA

```
                        ;INDIVIDUAL I/O ROUTINES
                        ;***********************
                        ;
                        ;THIS EXAMPLE USER AREA IS SET UP FOR THE
                        ;22K DISTRIBUTION SYSTEM. AND FOR THE ALTAIR
                        ;SIO (REV NON-ZERO) BOARD
                        ;
                        ;IT IS SUPPLIED AS A PROTOTYPE FOR MODIFICATION
                        ;BY USERS WHO WISH TO MODIFY THEIR SYSTEMS
                        ;
                        ;CHANGE MSIZE TO THE NOMINAL SYSTEM SIZE DESIRED
0016 =                  MSIZE   EQU     22      ;DISTRIBUTION SYSTEM
                        ;
5600 =                  BIOS    EQU     (MSIZE*1024) - 200H
5C00                    USER    ORG     BIOS+600H
0003 =                  IOBYTE  EQU     3       ;USE INTEL CONVENTION
                        ;
                        ;CHANGE TO THE APPROPRIATE VALUES FOR I/O
                        ;HARDWARE TO BE USED.  SEE THE INSTRUCTIONS
                        ;ACCOMPANYING YOUR I/O BOARD FOR CORRECT
                        ;INITIALIZATION AND DRIVERS
0000 =                  TTS     EQU     0       ;CONSOLE STATUS PORT
0001 =                  TTD     EOU     1       ;CONSOLE DATA PORT
0001 =                  TTYDA   EQU     1       ;RDA MASK FOR CONSOLE
0080 =                  TTYBE   EQU     80H     ;TBE MASK FOR CONSOLE
                        ;
                        ;THE JUMP TABLE FOLLOWING MUST BE PRESENT
                        ;IN THE CORRECT SEQUENCE
5C00 C3185C     CINIT   JMP     CINITR  ;COLD INIT
5C03 C31E5C     WINIT   JMP     WINITR  ;WARM INIT
5C06 C31F5C     CONST   JMP     TTYST   ;CONSOLE STATUS
5C09 C3285C     CONIN   JMP     TTYIN   ;CONSOLE INPUT
5C0C C3375C     CONOUT  JMP     TTYOUT  ;CONSOLE OUTPUT
5C0F C3375C     LIST    JMP     TTYOUT
5C12 C3375C     PUNCH   JMP     TTYOUT
5C15 C3285C     READER  JMP     TTYIN
                        ;
                       ;CONSOLE DEVICE USED TO TAKE PUNCH AND LIST
                       ;OUTPUT, AND TO RECEIVE READER INPUT
                       ;
```

```
                CINITR  ;COLD INITIALIZATION ROUTINE.
                        ;IN THIS CASE WE SET THE IOBYTE
                        ;TO PERMIT ERROR RECOVERY
5C18 3E01               MVI     A,1
5C1A 320300             STA     IOBYTE
5C1D C9                 RET
                ;
                WINITR  ;WARM INITIALIZATION ROUTINE.
                        ;NONE REQUIRED, SO A RETURN
5C1E C9                 RET
                ;
                TTYST   ;CONSOLE STATUS ROUTINE
5C1F DB00               IN      TTS
5C21 E601               ANI     TTYDA
5C23 3E00               MVI     A,0
5C25 C0                 RNZ             ;A=0 IF KEY
5C26 2F                 CMA
5C27 C9                 RET             ;A=0FFH IF KEY
                ;
                TTYIN   ;CONSOLE INPUT ROUTINE
5C28 DB00               IN      TTS
5C2A E601               ANI     TTYDA
5C2C C2285C             JNZ     TTYIN
5C2F DB01               IN      TTD
5C31 E67F               ANI     127
5C33 CA285C             JZ      TTYIN   ;IGNORE NULLS
5C36 C9                 RET
                ;
                TTYOUT  ;CONSOLE OUTPUT ROUTINE
5C37 DB00               IN      TTS
5C39 E680               ANI     TTYBE
5C3B C2375C             JNZ     TTYOUT
5C3E 79                 MOV     A,C
5C3F E67F               ANI     127
5C41 D301               OUT     TTD
5C43 C9                 RET
```

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