CP/M on MITS DISK

USERS NOTES

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INTRODUCTION TO THESE NOTES

This set of CP/M on MITS 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:

Section I. STARTING OUT

Upon receiving your CP/M on MITS 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 MITS Disk 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

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 MITS 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 remove the write protect notch tab (thus write protecting the disk) and then make a working copy of the distribution diskette. There are various programs which have been written under MITS basic that do this. If you cant copy the disk immediately, then do so using the COPY.COM utility as soon as CP/M is running.

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 most of them is described in the manual "Introduction to Features and Facilities". Additionally, ASM, ED and DDT have their own separate manuals.

MOVCPM.COM	- System relocator
ASM.COM	- Assembler
DDT.COM	- Debugger/Monitor
DUMP.COM	- Disk hex dump
ED.COM	- Editor
LOAD.COM	- Hex file loader
PIP.COM	- File transfer utility
STAT.COM	- File size and disk space utility
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 CP/M system. They all prompt the user at each step and may be run without fear of ruining something.

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.
All sectors will be filled with 0E5 hex.

COPY.COM - Disk copy program
The program will prompt you to select various options to copy the CP/M system, files, etc.
In particular, the "A" option copies all 77 tracks onto a blank disk and also formats it.

SAVEUSER.COM - Quickly writes BIOS "patches" to disk by writing the MODE byte sector and USER AREA from memory in the running system onto the disk.

CONFIC.COM - Configures the USER AREA for commonly used I/O.

USER.ASM - Source listing of sample USER AREA.

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. MITS disk system with 0FF00 hex PROM boot board.

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 "24K" 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 two page (512 byte) area on disk. This is the area that contains your console and other device drivers.

The following table will list the locations of various CP/M molules in both the distribution 24K 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.

*** DISK PARAMETERS ***

	ON DISK TRACK	SECTOR	IN SYSGEN ADDRESS	24K SYSTEM ADDRESS
BOOT	0	1 AND 3	900H	0
CCP	0	4	0A80H	4400H
BDOS	0	20	1280H	4C00H
BIOS	1	14	1F80H	5900H
MODE	1	24	247FH	5DFFH
USER	1	24-27	2480H	5E00H
EXTRA	1	28-32	2680H	6000H

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 or Cold Boot.
4. Disk I/O primitives.

The choice of these 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 5DFF hex in the standard 24K system (247F 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
DAD     B       ;Add HL and BC registers
                ;to point to MODE byte
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 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 degredation in the speed of disk reading, but will slow disk writing by a factor of about four times.

The position of this bit is value 40 hex (bit 6). 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 (bit 4). 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 COLD OR 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 if invoked. The user must provide the program AUTO.COM or re-name a program to that name. You may activate the Auto feature on each warm boot, cold boot or both.

The position of this bit is value 1 (bit 0) for activation on warm boots and value 2 (bit 1) for activation on cold boots. This distribution system is shipped with these bits set LOW and thus this feature is NOT active.

Option 4. DISK I/O PRIMITIVE

Normal disk reads and writes under this CP/M system follow the MITS format for system tracks (0 thru 5) and file tracks (6 thru 76) which is fully described in both the MITS Basic and DOS manuals. Error checking is done automatically under this format. All disk reads and writes are done from an internal 139 byte buffer whose address is contained at memory address BIOS+5FCH. If for any reason you do not wish to use the standard format, you may elect to read or write 139 bytes directly to or from this buffer. To use this method, first set the mode byte, then call SELDSK, SETTRK and SETSEC in the normal manner. Note SETDMA has no effect. If READ is then called, the buffer will be filled with 139 bytes from disk. To write, first

fill the buffer with 139 bytes of whatever you wish, then call WRITE to transfer these bytes to disk. The routines referred to above are in the CP/M BIOS jump table. If you choose to use this method remember no error checking of any kind will be done by CP/M - its up to you. Also, the first bit of the first byte in each sector must be set to 1. The value of the bit controlling primitive disk I/O is 8 (bit 3). The position of this bit is LOW and thus this feature is NOT active.

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 as outlined in the section on CHANGING THE SYSTEM SIZE. Use STAT.COM to find the size of the program you wish to run. Then generate a CP/M system 8K larger. For example, if the program has a size of 28K as given by STAT, you must generate a 36K CP/M system.

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 store it on sectors 1,2,3,4 and 5 in that order but would 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. The sequence used for MITS disk CP/M is:

1,9,17,25,3,11,19,27,5,13,21,29,7,15,23,31
2,10,18,26,4,12,20,28,6,14,22,30,8,16,24,32

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. You may alternatively format a new disk by simply making a copy of a CP/M disk already in use with the COPY.COM utility. Just type the command "COPY" and the program will give you a menu - use the "A" option to format a raw disk completely.

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. We suggest you read this section several times to get a "feel" for the procedure. Make sure you have at least 24K of RAM memory starting at 0. Please try to use a "working" disk which is a COPY of the distribution diskette. All tracks should have been copied. If you MUST use the original, first write protect it by removing the tab. The step by step procedure now follows. Throughout this text, CR in a command means a carrige return.

Step 1. Power up computer and disk system.

Step 2. Insert working disk in drive A (Left hand drive).

Step 3. Use your monitor or front panel to run the computer from address 0FF00 hex, which is the location of the standard MITS boot PROM. The front panel switches need not be specially set as when booting in MITS basic or DOS.

Step 4. You should get disk activity which will stop in about 20 seconds. The system will come to a soft halt at 103 hex and will NOT sign-on at this time. Step 5. Look in the table of configurations at the end of this section for the one pertaining to your I/O devices. You will find a configuration number on the left.

Step 6. Use your front panel switches, monitor or other facility to deposit your selected configuration number in memory at location 120 hex. Step 7. If you know you need a particular option, deposit the option number at location 121 hex. Skip this step if you dont know what to do as the system will default to the most common case.

Step 8. Use your front panel, monitor or other facility to RUN the computer starting at memory location 100 hex. You should get a sign-on message of the form:

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

Step 9. At this point you have a working CP/M system patched in memory with your I/O. If you have been using the original diskette, make a working copy now by typing "COPY". The program will prompt you what to do, use the "A" option. After making the copy, put the original away and put the working copy into drive A.

Step 10. Permanently write the patched system onto your disk at this time by typing "SAVEUSER CR". The program will prompt you.

Step 11. Test the system by removing all disks, cycling computer power (to wipe memory), re-inserting the patched disk in drive A and doing another cold boot by going to 0FF00 hex.

Step 12. The disk should activate and you should get a sign-on message like this:

```
CP/M on MITS Disk
24K Version 1.41
Copyright (C) 1979 Lifeboat Associates

A>
```

Congratulations, your system is on the air.

Step 13. Now permanently patch CONFIG.COM with your selected configuration number at 120 hex. This will cause the configurator to run automatically in the future. Follow this procedure:

Type: DDT CONFIG.COM CR.
The system will respond with:

```
DDT VERS 1.4
NEXT    PC
0B00    0100
-
```

Type: S120 CR
System will respond: 0120 FF
Type the hex byte for your system (eg 5 for Imsai MIO) followed by a CR.
The system will respond: 0121 A0.
Type the option number for your system if any followed by a CR.
The system will respond: 0122 A0.
Type a period followed by CR to exit the "S" mode.
Type a control C.
The system will return to A> prompt.
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 0B00H in memory.
The system configurator program, CONFIG.COM has now been preset to your desired configuration.

IN CASE YOUR DEVICE IS NOT LISTED

If you were not able to find a configuration in the table that pertains to your devices, in Step 6 above use configuration number 2. This will set up your USER AREA as per the listing in Appendix A. You will not get a sign-on message after Step 8. Instead, after Step 8, use your monitor, front panel switches or other facility to hand patch the USER AREA. After you have done this patching, RUN the computer from memory location 0. This will cause a warm boot. If your patches are correct, the disk should activate and the computer should sign on with a simple "A>". Then, go to Step 9 and continue.

The USER AREA is a two page (512 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 490) 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.COM 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 USER AREA.

LIST OF STANDARD CONFIGURATIONS

CONFIG NUMBER	TYPE OF DEVICE	OPTION
0.	Altair 88-2SIO	A
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	
82.	Xitan SMB (Zapple)	
83.	North Star Horizon	
84.	Vector Graphic MZ	

Option A. Deposit 1 for 1 stop bit, default is 2 stop bits.

Note: Deposit configuration numbers at 120 hex, options at 121 hex.

Section VIII. CHANGING THE SYSTEM SIZE

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 system size will result in a LOAD ERROR message. To enlarge the system to utilize more memory it is necessary to employ the MOVCPM relocation utility. The step by step procedure follows.

Step 1. Prepare a diskette with a CP/M system and containing the programs MOVCPM.COM, CONFIG.COM, SYSGEN.COM AND SAVEUSER.COM. You should have preset CONFIG.COM for your configuration per Step 12 in the previous section.

Step 2. Place the disk in drive A and cold boot.

Step 3. Type command: MOVCPM XX CR. XX is the amount of memory you wish to use in decimal K. (Type MOVCPM * CR to use all of available memory) The MOVCPM program 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.

Step 4. Type command: SYSGEN CR. The SYSGEN program will sign-on:

```
Sysgen Vers 1.3
for MITS Disk

Source drive name (or RETURN to skip)
```

Type a CR since the system is already in memory at the SYSGEN POSITION starting at 900H and need not be fetched from the system tracks of a diskette. The program will continue:

```
Destination drive name (or RETURN to reboot)
```

Type: A CR which signifies 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 on drive A so simply hit CR. SYSGEN will offer another opportunity to write the system with:

```
Function complete
Destination drive name (or RETURN to reboot)
```

Step 5. You now have an unconfigured system of the proper size on disk. At this point do NOT type a return, since a warm boot which would follow would fail because the system in memory (24K) is different from the system that is now 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>
```

Step 6. Type command: SAVEUSER CR
The program will prompt you to type a CR to patch the configuration onto the disk system tracks. A trial cold boot now should cause the system to sign-on with the correct new system size in the message.

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 USER.ASM contains a sample USER AREA. Changes may be made in this file to suit your own purposes and then implemented in your system. Modify this file using the CP/M editor ED.COM. 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 USER.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 38 CPM24.COM" . Now make sure you are logged in on the same drive as the USER.HEX file so that it can be inserted by DDT. Bring the existing system back to the SYSGEN POSITION by the command "DDT CPM24.COM". Now overlay the original USER AREA (2480 to 267F hex) with your new USER.HEX file using the two commands "IUSER.HEX" and "R<OFFSET>". OFFSET for a 24K system is 0C680 hex. For other size systems the correct OFFSET is given in the USER.ASM file and represents the difference from where the USER AREA actually runs in memory (at 5E00 hex for a 24K system) to its location in the SYSGEN POSITION which is always 2480 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 38 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 sector containing the MODE BYTE and the four sectors containing the USER AREA 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

```
                        ;SAMPLE USER AREA
                        ;FOR 3P+S USING MITS REV NON-ZERO I/O
                        ;THIS IS IDENTICAL TO CONFIGURATION NR 2.
                        ;
                        ;       THIS VERY SIMPLE TELETYPE DRIVER WOULD
                        ;BE JUST ENOUGH TO GET YOUR CP/M SYSTEM RUNNING.
                        ;       NOTE THE LIST, PUNCH AND READER DEVICES ARE
                        ;NOT IMPLEMENTED, THEY GO DIRECT TO TTYIN AND TTYOUT.
                        ;       ALSO, THE STATUS ROUTINE MAY WAIT
                        ;UNTIL LATER WHEN CP/M FACILITIES ARE AVAILABLE.
                        ;TO DO THIS, REPLACE TTYST WITH XRA A AND RET
                        ;JUST LIKE IN THE TTYPRST ROUTINE.  CP/M WILL
                        ;OPERATE THE SAME EXCEPT CONSOLE "BREAK" WONT WORK.
                        ;       THE VARIOUS OCCURENCES OF "DB 0"
                        ;ARE TO PROVIDE PLENTY OF ROOM FOR PATCHING.
                        ;
                        ;EQUATES
0018 =                  MSIZE   EQU     24                  ;CP/M SYSTEM SIZE IN KBYTES
2000 =                  BIAS    EQU     (MSIZE-16)*1024
5900 =                  BIOS    EQU     3900H+BIAS          ;LOCATION OF BIOS
5E00 =                  USER    EQU     BIOS+500H           ;START OF USER AREA
C680 =                  OFFSET  EQU     1F80H-BIOS          ;TO SYSGEN IMAGE
                        ;
                        ;TTY EQUATES
0000 =                  STATUS  EQU     0                   ;TTY STATUS PORT
0001 =                  DATA    EQU     1                   ;TTY DATA PORT
0001 =                  RDA     EQU     1                   ;DATA AVAILABLE MASK
0001 =                  RDAMSK  EQU     RDA                 ;SENSE IS ACTIVE LOW
0080 =                  TBE     EQU     80H                 ;BUFFER EMPTY MASK
0080 =                  TBEMSK  EQU     TBE                 ;SENSE IS ACTIVE LOW
                        ;
5E00                            ORG     USER                ;5E00H IN DIST SYSTEM
                        ;
                        ;JUMP TABLE - JMPS MUST REMAIN HERE, IN SAME ORDER
5E00 C3595E             INIT    JMP     INITR               ;INITIALIZATION
5E03 C3205E             CONST   JMP     TTYST               ;CONSOLE STATUS
5E06 C3305E             CONIN   JMP     TTYIN               ;CONSOLE INPUT
5E09 C3405E             CONOUT  JMP     TTYOUT              ;CONSOLE OUTPUT
5E0C C3405E             LIST    JMP     TTYOUT              ;LIST OUTPUT
5E0F C3405E             PUNCH   JMP     TTYOUT              ;PUNCH OUTPUT
5E12 C3305E             READER  JMP     TTYIN               ;READER INPUT
5E15 C3505E             PRST    JMP     TTYPRST             ;PRINTER STATUS
5E18 000000                     DB      0,0,0
5E1B 8000                       DW      TTYLEN              ;LENGTH
5E1D 000000                     DB      0,0,0
                        ;
                        ;CONSOLE STATUS, RET 0FFH IF CHAR READY, 0 IF NONE
                        TTYST:
5E20 DB00                       IN      STATUS              ;GET STATUS BYTE
5E22 00                         DB      0
```

```
5E23 E601           ANI     RDA             ;EXAMINE STATUS BIT
5E25 EE01           XRI     RDAMSK          ;MAKE ACTIVE LOW
5E27 3E00           MVI     A,0
5E29 C0             RNZ                     ;0 IF NO KEY
5E2A 2F             CMA                     ;0FFH IF KEY
5E2B C9             RET
5E2C 00000000       DB      0,0,0,0
                    ;
                    ;CONSOLE INPUT CHAR TO REGISTER A
                    TTYIN:
5E30 DB00           IN      STATUS          ;GET STATUS BYTE
5E32 00             DB      0
5E33 E601           ANI     RDA             ;EXAMINE STATUS BIT
5E35 EE01           XRI     RDAMSK          ;MAKE ACTIVE LOW
5E37 C2305E         JNZ     TTYIN           ;LOOP FOR CHAR
5E3A DB01           IN      DATA            ;INPUT THE CHARACTER
5E3C 00             DB      0
5E3D E67F           ANI     7FH             ;STRIP  PARITY
5E3F C9             RET
                    ;
                    ;CONSOLE OUTPUT CHAR FROM REGISTER C
                    TTYOUT:
5E40 DB00           IN      STATUS          ;GET STATUS BYTE
5E42 00             DB      0
5E43 E680           ANI     TBE             ;EXAMINE STATUS BIT
5E45 EE80           XRI     TBEMSK          ;MAKE ACTIVE LOW
5E47 C2405E         JNZ     TTYOUT          ;LOOP FOR CHAR
5E4A 79             MOV     A,C             ;CHAR INTO C REG
5E4B D301           OUT     DATA            ;AND OUTPUT
5E4D 00             DB      0
5E4E C9             RET
5E4F 00             DB      0
                    ;
                    ;PRINTER STATUS CHECK, NOT YET IMPLEMENTED
                    TTYPRST:
5E50 000000         DB      0,0,0
5E53 AF             XRA     A               ;NO CHAR READY
5E54 C9             RET                     ;SO RET WITH ACC=0
5E55 00000000       DB      0,0,0,0
                    ;
                    ;INITIALIZATION ROUTINE GOES HERE IF NEEDED
                    ;MAKE SURE IT ENDS WITH A RET.
                    INITR:
5E59 C9             RET
5E5A                DS      38              ;ROOM FOR INIT
                    ;
0080 =              TTYLEN EQU  $-INIT      ;LENGTH OF THIS ROUTINE
                    ;
```