CP/M ON THE LYNX

CONTENTS

INTRODUCTION

This manual is divided into two parts.

The first part is intended for new users, and covers how to get started, and how to 'back up' (copy) your Master Disk using some of the Utilities Programs on your disk.

The second part is a technical overview of Camsoft's implementation of CP/M, intended for more advanced users and systems programmers. It covers the use of the terminal and IOBYTE, altering the BIOS, and so on. New users should ignore this section.

Besides this manual, you will have been supplied with several others.

Lynx DOS manual

Although you don't need to know anything about the Lynx's own Disk operating System -- or even about the Lynx itself -- to use CP/M, the DOS Manual covers some important general topics like how to set up your disk system, how to care for disks, and the meanings of error messages. So it is strongly recommended that you read these parts of the DOS Manual before you try to use CP/M.

CP/M Operating System Manual.

This is Digital Research's own manual and contains detailed information about the CP/M system and Utility Programs, and how to use them.

PERFECT SOFTWARE manuals.

These cover the three business packages -- PERFECT WRITER, PERFECT FILER and PERFECT CALC -- which are supplied with the Lynx CP/M system.

PART ONE: GETTING STARTED

BOOTING CP/M

Initialising an Operating System -- like CP/M -- is called "booting".

Set up your Lynx system following the instructions in Chapter 3 of the Lynx DOS manual, then initialise Lynx DOS by typing

XROM [RETURN]

The Lynx will display

Lynx DOS...

at the top of the screen. Insert the CP/M disk into Drive A and type

EXT BOOT [RETURN]

The screen will clear and the Lynx will then display the introductory message:

CP/M vers 2.2 Copyright Digital Research
BIOS vers 1.0 128K Lynx, Copyright Camputers.

And the system prompt

A>

with a cursor will appear. The "A" indicates that the system is using Drive A, and it will assume that any commands you give it apply to that drive. It will do so until you change the logged-on drive.

REBOOTING

Should you want to reset CP/M, you can perform a "warm boot" with

[CONTROL] C

(pressing the two keys simultaneously).

ERRORS

If you are given an error message, consult Chapter 7 of the Lynx DOS manual.

THE DIR COMMAND

The DIR command displays the Directory -- the list of files -- of the disk in the drive currently being used.

If you type

DIR [RETURN]

the Lynx will display the names of all the files on your CP/M disk.

BACKING UP YOUR DISK

Before you use CP/M you must make a back up copy of your CP/M Master Disk.
First make sure that the disk is write protected (see Chapter 5 of the DOS
manual). Then read this section through completely before you begin.

There are three stages to the back up process

1) Formatting a disk -- using FORMAT.COM
2) Copying the CP/M system -- using SYSGEN.COM
3) Copying the files -- using PIP.COM

FORMATTING A DISK

Formatting prepares a disk for use. Anything already stored on the disk will
be destroyed. So be careful not to use a disk containing important material.

Insert the disk to be formatted into Drive B. Type

FORMAT [RETURN]

and the Lynx will load the format program, and display

Lynx disk format program...
Format Disk in which drive (A,B,C,D)?

Remove your CP/M Master Disk from Drive A (to guard against accidents) and
select Drive B for formatting. Follow the on-screen instructions. The Lynx
will display the numbers of the tracks as it formats them.

Once the formatting is complete, the system prompt will reappear.

COPYING THE CP/M SYSTEM

Replace your CP/M Master Disk into Drive A. Type

SYSGEN [RETURN]

The Lynx will display

Sysgen vers 2.0
Source Drive name (or RETURN to skip)

Select Drive A, then follow the on-screen instructions.

COPYING THE FILES

PIP is used to copy files from disk to disk. First load it by typing

PIP [RETURN]

The Lynx will display a special * prompt. To copy all the files, type

B:=A:*.*[OV] [RETURN]

The files will be copied from A to B, with each file verified as it is copied. When the copying is complete, the * prompt will reappear.

Press .[RETURN] to go back to CP/M.

To check your new disk, type

DIR B: [RETURN]

and the Lynx should display a list of the files on disk B.

PERFECT SOFTWARE

The Lynx CP/M system is supplied with four business programs:

PERFECT WRITER -- a word processing package -- plus a "lesson" disk
PERFECT SPELLER
PERFECT FILER -- a database package -- plus two ready-made database disks
PERFECT CALC -- a speadsheet package -- plus a "lesson" disk

Each program is fully documented in a Perfect manual -- supplied with the system -- which includes a beginner's introduction.

COPYING PERFECT SOFTWARE

Before you use Perfect Software you should back up all of the disks. If you are not already familiar with CP/M, the following routine should be trouble free:

First format 8 new disks.

Next, place your CP/M system disk (Write Protected) in Drive A and one of the newly formatted disks in Drive B.

Type [CONTROL] C (holding the [CONTROL] key down whilst you press C).

Then type PIP [RETURN]

The Lynx will load PIP into its memory and display the special PIP prompt *.

Remove the CP/M system disk and replace it with the disk you want to copy (WRITE PROTECTED!). Type

B:=A:*.*[OV] [RETURN]

The Lynx will then copy each file on disk A across to disk B, displaying the file name as it copies it.

When the copy is complete the prompt will reappear.

To copy the next disk, go right back to the beginning -- put the CP/M system disk in A, an empty disk in B, press

[CONTROL] C

and so on, until you have copied all your disks. Don't forget to label them.

ADDING THE CP/M SYSTEM

In addition, you will need to add SYSGEN -- the CP/M system -- to your copies of WRITER, SPELLER, FILER and CALC.

Place your CP/M disk in A -- and nothing in B -- type

[CONTROL] C

then

SYSGEN [RETURN]

Give A as the source, and SYSGEN will be loaded into memory. The computer will then ask for a destination drive. Select

B

then · add SYSGEN to each of the four disks in turn, following the on-screen instructions.

RUNNING PERFECT SOFTWARE ON THE LYNX

It is especially important to back up Perfect Software because IT WILL NOT RUN PROPERLY IF WRITE PROTECTED.

TO RUN PERFECT WRITER:
Type

XROM [RETURN]

Place the disk in Drive A, type

EXT BOOT [RETURN]

then when the prompt appears, type

MENU [RETURN]

and Perfect Writer's main menu will appear on the screen.

TO RUN PERFECT FILER:
Follow a similar procedure BUT ALSO PLACE A DATA BASE DISK IN DRIVE B and instead of MENU, type

FILER [RETURN]

(Note that two ready-made data base disks are supplied with the package).

TO RUN PERFECT CALC:
Follow a similar procedure to that given for Writer, but instead of MENU, type

PC [RETURN]

USING A SERIAL PRINTER

The CP/M system is configured to use a parallel printer together with the parallel printer interface.

If you want to use a serial printer, make sure you have the STAT.COM file on your disk and type

STAT LST:=CRT:

List output will now be sent via the serial port.

Note that the next BOOT command will reset the list device to parallel printer.

For more details of the output routines see Part Two.

PART TWO

SCREEN EDITING

Several escape sequences which add to the standard CP/M 2.2 editing commands
are listed in the appendix. You can reset ink and paper colours, for example.
If you're using a program which needs lot of screen handling you can cut
screen access to just one video bank using the [ESC] G sequence. This will
speed up the display.

CP/M scrolls whenever it is asked to print off the bottom of the screen.

THE STAT COMMAND

When CP/M sends information to the screen, it is sending its data to the CON:
device and Lynx CP/M is configured to direct all output for the CON: device to
the screen. Using the [CONTROL] P command you can also send output to the LST:
device, usually a printer.

The STAT command allows you to choose your CON: and LST: devices, as well as
the PUN: and RDR: devices.

The table below gives the possibilities for reassigning logical devices using
STAT:

        logical device   physical devices

            CON: TTY: CRT: BAT: UC1:
            RDR: TTY: RDR: UR1: UR2:
            PUN: TTY: PUN: UP1: UP2:
            LST: ·TTY: CRT: LPT: UL1:

Physical device configuration for the Lynx:

            TTY   Video display
            CRT   Serial output
            RDR   Serial input
            PUN   Serial output
            BAT   Batch mode
            LPT   Parallel printer (with control char modifiction)
            UL1   Serial printer (with control chracter modification)
            UP1   Serial output without handshake

UC1, UR1, UR2 and UP2 are user definable and default to the video display.

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ALTERING THE BIOS

There are a number of modifications you can make to the BIOS.

CHARACTER SETS

Two labels, shortly after the BIOS jump table (at E700H), hold pointers to the selected character sets.

CHRPT for characters 20 - 80H value should point 240H below the base of the set.

GRAPT for characters greater than 80H points to the base of this set.

The screen treats characters as 6 bits wide and 10 bytes deep.

THE BREAK KEY

In the BIOS, soon after the jump table at E700H, is a region labelled BRKPCH which contains 3 bytes set to 201 (the Z80 RETURN instruction). To make the [BREAK] key jump to your own routines, replace the 3 bytes with a jump instruction. If you are adding a subroutine, preserve all the register values except the HL and AF, which you can safely use.

PRINTER ROUTINES

The parallel and serial printer routines (the LPT: and UL1: devices) use bytes which are held in RAM between 61BCH and 61BFH when the machine is powered up. The bytes are copied into the BIOS from ED2FH to ED32H at cold start and affect the treatment of control characters sent to the printer.

The significance of these bytes is outlined in the Lynx Printer Technical Manual. If you want to make changes, it is best to alter these bytes before booting CP/M. Alternatively, a small CP/M program could be written to change the bytes in the BIOS, located at ED2FH, after booting.

LST: DEVICE OUTPUT

The difference between UL1: (serial printer) and CRT: (serial output) is simply that the UL1: device will mask out appropriate control characters (as specified in the Lynx Printer Technical Manual) whilst with the CRT:, all output goes to the serial output port unmodified. Use the CRT: if you are unsure.

Note that if you use EXT SPRINT under the Basic O/S to configure the Lynx to serial printer, then cold boot CP/M and use

STAT LST:=UL1:

(send all list output to the serial printer device)

then the printer will generally issue TWO linefeeds to every CR LF
combination. See the Lynx Printer Technical Manual for details.

USER DEFINED DEVICES

The user devices default at present to the video screen. The relevant area of
the BIOS is approximately EC80H.

BIOS listing			Physical device
LSTTAB	DW	PARALLEL	LPT
	DW	SERPTR	UL1
CONTAB	DW	BATCH	BAT
	DW	DVR128K	UC1
RDRTAB	DW	DVR128K	UR1
	DW	DVR128K	UR2
PUNTAB	DW	SER02	UP1
	DW	DVR128K	UP2

PARALLEL and SERPTR point to the parallel and serial printer routines. So if a
routine for the UR1 device was at 8000H, the change would just be

RDRTAB DW   8000H

USER ROUTINES

If you include any of your own routines, be careful not to disable the
interrupts or change the interrupt mode, because the video and keybord
routines are interrupt driven. Full lists of the Control Codes and Escape
Sequences are given in Appendices A and B.

```
                MEMORY MAP
----------------------    FFFFH TOP OF MEMORY

     BIOS

----------------------    E700H

     BDOS
     CCP

----------------------    D100H

     TPA

----------------------    100H

     SYSTEM AREA

----------------------
```
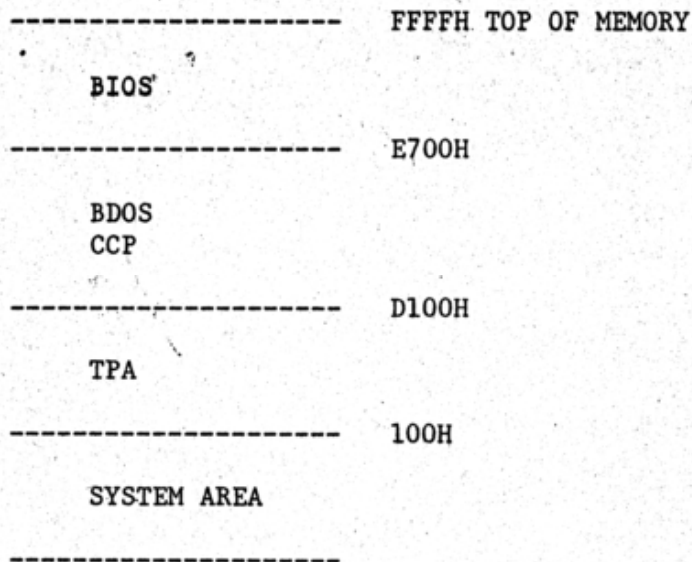
The memory map shows that 52K is free for your own programs. The diagram
should also be of use if you want to alter the existing CP/M.

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SERIAL COMMUNICATION

The BIOS includes support for the Lynx's RS232 compatible serial communication
port. Electrical details of the connection and pin-out are given in the Lynx
User Manual.

The range of Input and Output formats supported is:

110 - 38,400   BAUD
 5 - 8   DATA BITS
 1 or 2   STOP BITS.
odd, even or off   PARITY

The simplest way to configure the port is to use the EXT SERIAL commands of
the Basic Operating System. The O/S sets up 10 (decimal) bytes starting at
6975H which store the serial parameters. At cold boot these 10 bytes are
copied into the BIOS at location ED36H. The device drivers can be dynamically
reconfigured by changing these 10 bytes

    DEFAULTS

    2400   BAUD
    8   DATA BITS
    2   STOP BITS
    PARITY OFF

SIGNAL POLARITIES

Data Lines: stop bit - low voltage
                   start bit - high voltage

Handshake Lines: Ready - high voltage
                  Busy - low voltage

These are the levels the Lynx will output, and the expected input levels.

LEVEL DEFINITION (as per RS232)

Low (negative) voltage = binary "1" = signal condition "marking"
                                              = function off

High voltage = binary "0" = signal condition "spacing" = function on

HANDSHAKE

The serial input routines will operate the H/S out line as specified above
under "Signal Polarities". The serial output routines will test H/S in
similarly. If the receiving device does not have this handshake capability,
you have two options:

1)   Wire "H/S" in to a high voltage -- so the receiving device appears always

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ready to receive.

2) Assign the punch device to UP1:

    STAT.PUN: = UP1:

and send the output via the punch device (with, for instance, PIP --
PIP PUN: = FILE.LST)

UP1 is a restricted serial output routine which does not test handshake in.

APPENDIX A: CP/M 2.2 CONTROL CHARACTERS

The following list gives the control characters which can be entered from the keyboard.

[CONTROL] C	Warm Boot
[CONTROL] E	Move Cursor to next line
[CONTROL] G	Bell
[CONTROL] H	Delete last character
[CONTROL] I	Tab
[CONTROL] J	Linefeed
[CONTROL] M	Carriage Return
[CONTROL] P	Switch Printer on/off
[CONTROL] R	Places £ at Cursor position echoes line
[CONTROL] S	Delay printing
[CONTROL] U	Places £ at old Cursor position moves cursor to next line
[CONTROL] X	Deletes present line
[CONTROL] Z	Clear screen

APPENDIX B: ESCAPE SEQUENCES

The following Escape sequences can be sent to the console output routines or directly accessed from the keyboard if terminated by carriage return.

SEQUENCE	ASCII CODES	FUNCTION
[ESC] C +	1B 43 2B	Display Cursor
[ESC] C -	1B 43 2D	Switch off Cursor
[ESC] G	1B 47	Green Text Mode
[ESC] I n	1B 49 (n=30 to 37)	INK n (see Lynx manual)
[ESC] N	1B 4E	Scroll off
[ESC] P n	1B 50 (n=30 to 37)	PAPER n (see Lynx manual)
[ESC] Q	1B 51	Colour Mode
[ESC] R	1B 52	Reverse INK/PAPER
[ESC] S	1B 53	Scroll on
[ESC] = n n	1B 3D r c	New r,c Cursor position

CURSOR POSITIONING

[ESC] = r c

r = row + 20H   c = column + 20H

The screen is 80 columns by 24 rows. So, for example,

HOME is = space space

row 4,column 9 is = $)

Note that the cursor positions entered from the keyboard may appear to be incorrect, as lower case letters will be converted to upper case before being sent to the screen driver. Sequences sent to CONOUT will produce correct positioning.

BOOT-UP DEFAULTS

The defaults at boot up are

        C +
        G
        S

In Q mode, the cursor is a non-flashing blue block. Note that screen update speed is increased by a factor of 2 or 3 in G mode, compared to Q mode. This is true even if the only coloured part of the screen in Q mode is the cursor.

APPENDIX C: CONSOLE OUTPUT CONTROL CODES

The table below gives the meaning of control codes sent to the console output
routine, BDOS function 2.

[CONTROL] G	Bell
[CONTROL] H	Backspace
[CONTROL] J	Linefeed
[CONTROL] K	Cursor up
[CONTROL] L	Cursor right
[CONTROL] M	Carriage Return
[CONTROL] T	Clear to end of line
[CONTROL] U	Delete character and backspace rest of line
[CONTROL] V	Insert space at character position
[CONTROL] Y	Clear to end of screen
[CONTROL] Z	Clear screen
[CONTROL] >	Home

This Appendix contains various extracts from the 128K BIOS listing, including user modifiable portions. Copyright (c) CAMSOFT 1984

```
***************************************************
*            CP/M JUMP VECTOR TABLE              *
***************************************************
```

E700	C3 E703			JP	WBOOTE	;COLD START ENTRY
E703	C3 E765		WBOOTE:	JP	WBOOT	;WARM START ENTRY
E706	C3 EC46			JP	XCONST	;CONSOLE STATUS
E709	.C3 EC39			JP	XCONIN	;CONSOLE INPUT
E70C	C3 EC43 ·			JP	XCONOUT	;CONSOLE OUTPUT
E70F	C3 EC5F			JP	XLIST	;LIST ROUTINE
E712	C3 EC58			JP	XPUNCH	
E715	C3 EC4F			JP	XREADER	
E718	C3 E81F			JP	HOME	;SEEK TO TRACK 0
E71B	C3 E83D			JP	SELDRV	;SET DRIVE NUMBER
E71E	C3 E82B			JP	SETTRK	;SET TRACK
E721	C3 E830			JP	SETSEC	;SET SECTOR
E724	C3 E835			JP	SETDMA	;SET MEMORY R/W ADDRESS
E727	C3 E86D			JP	READ	;READ SECTOR
E72A	C3 E876			JP	WRITE	;WRITE SECTOR
E72D	C3 EC31			JP	XLISTST	;LIST STATUS
E730	C3 E83A			JP	SECTRN	;SECTOR TRANSLATE

TABLE AREA - USER MODIFIABLE

E733	EC87		DW	UDEV	;POINTER TO USER ;DEVICES
E735	54	IIOBYT:	DB	01010100B	;INITIAL IOBYTE
E736	00	BOOTDRV:	DB	0	;BOOT DRIVE SET UP AT ;COLD BOOT TIME
E737	00	DRVTYP:	DB	00000000B	;DRIVE TYPE BYTE - ;A=C=D=00 = 200K ;B=01 = 800K
E738	01	AUTOFLG:	DB	00000001B	;B0 - SET = DISPLAY ;INITIAL MESSAGE ;B1 - CLEAR = SUPPRESS ;AUTO-EXECUTION

VARIOUS PARAMETERS FOR DVR128K SCREEN & KEYBOARD HANDLER

E739	0000	CHRPT:	DW	0	;CHARACTER POINTER
E73B	0000	GRAPT:	DW	0	;GRAPHICS POINTER

These two must be together for the cold start code

```
E73D    40              RPTDLY:  DB    40H
E73E    04              KEYDLY:  DB    4
E73F    F62E            KEYTBL:  DW    KEYVALS          ;POINTERS TO VARIOUS
                                                        ;TABLES
E741    F66A            SHFTBL:  DW    SHFVALS
E743    F6A6            CNLTBL:  DW    CNLVALS
E745    F51A            OFFTBL:  DW    OFFVALS



EC7E    ECB8            LSTTAB:  ▸DW   PARALLEL         ;TABLES DEFINE
                                                        ;PHYSICAL DEVICES FOR
                                                        ;ENTRIES
EC80    ECA9                     DW    SERPTR           ;2 & 3 IN IOBYTE

EC82    ECF3            CONTAB:  DW    BATCH


        The next 5 devices may be user defined


EC84    ECE8            UDEV:    DW    DVR128K
EC86    ECE8            RDRTAB:  DW    DVR128K
EC88    ECE8                     DW    DVR128K
EC8A    ECDE            PUNTAB:  DW    SERO2
EC8C    ECE8                     DW    DVR128K



            *****************************
            * PHYSICAL DEVICE ROUTINES *
            *****************************


On entry to each device a code in D indicates the function required:

            0 =   Input to A
            1 =   Output from C
            2 =   Input status in A


EC8E    F3              LCOMMON: DI
EC8F    FD E5                    PUSH IY                ;A,C AND IY TO BE
                                                        ;PRESERVED
EC91    FD 21 ED36               LD    IY,SIOPTR        ;POINTS TO SERIAL
                                                        ;BYTES
EC95    F5                       PUSH AF
EC97    D3 82                    XOR   A
EC97    F1                       OUT   (82H),A          ;SWITCH IN ROMS
EC99    F1                       POP   AF
EC9A    11 EC9F                  LD    DE,OUTLCOM
EC9D    D5                       PUSH DE                ;RETURN ADDRESS AFTER
                                                        ;ROM CALL
EC9E    E9                       JP    (HL)             ;ROM ROUTINE IN HL
                                                        ;CALLED
EC9F    F5              OUTLCOM: PUSH  AF               ;AF IS RESULT
ECA0    3E 08                    LD    A,8              ;SWITCH OUT ROM
```

```
ECA2    D3 82                           OUT    (82H),A
ECA4    F1                              POP    AF
ECA5    FD E1                           POP    IY          ;PRESERVES IY
ECA7    FB                              EI
ECA8    C9                              RET


ECA9    21 5FEC         SERPTR:  LD     HL,SERPS
ECAC    CD EC8E                  CALL   LCOMMON            ;CHECK SERIAL PRINTER
                                                           ;STATUS
ECAF    B7                       OR     A
ECB0    28 F7                    JR     Z,SERPTR
ECB2    21 5FEF                  LD     HL,SERPO           ;OUTPUT C CHAR TO
                                                           ;SERIAL PRINTER
ECB5    C3 EC8E                  JP     LCOMMON
ECB8    21 5FF2         PARALLEL: LD    HL,PARPS
ECBB    CD EC8E                  CALL   LCOMMON            ;CHECK PARALLEL
                                                           ;PRINTER STATUS
ECBE    B7                       OR     A
ECBF    28 F7                    JR     Z,PARALLEL
ECC1    21 5FF5                  LD     HL,PARPO           ;IF READY TO OUTPUT TO
                                                           ;PARALLEL PRINTER
ECC4    C3 EC8E                  JP     LCOMMON
ECC7    7A              SERIAL:  LD     A,D
ECC8    B7                       OR     A
ECC9    20 0A                    JR     NZ,SERIALO
ECCB    21 5FE9         SERIALI: LD     HL,SERI            ;IF D=0 INPUT FROM
                                                           ;SERIAL TO A
ECCE    CD EC8E                  CALL   LCOMMON            ;CARRY FLAG SET
                                                           ;INDICATES ERROR
ECD1    D0                       RET    NC
ECD2    3E 1A                    LD     A,26               ;CTL-Z: EOF CONDITION
                                                           ;IF ERROR
ECD4    C9                       RET
ECD5    3D              SERIALO: DEC    A
ECD6    20 0D                    JR     NZ,SERIALS
ECD8    DB 82           OUTSHAKE: IN    A,(82H)            ;TEST ONLY PORT 82H
ECDA    CB 47                    BIT    0,A                ;HANDSHAKE FOR OUTPUT
ECDC    20 FA                    JR     NZ,OUTSHAKE
ECDE    79              SERO2:   LD     A,C
ECDF    21 5FE6                  LD     HL,SERO            ;OUTPUT CHAR WHICH WAS
                                                           ;IN C
ECE2    C3 EC8E                  JP     LCOMMON
ECE5    3E FF           SERIALS: LD     A,255
ECE7    C9                       RET


ECE8                    DVR128K:
ECE8    15                       DEC    D
ECE9    CA EE57                  JP     Z,CONOUT
```

(The actual I/O routines for these are in an external module)

```
ECEC    15                       DEC    D
ECED    CA EE42                  JP     Z,CONST
```

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```
ECF0    C3 EE47                      JP    CONIN

ECF3    15              BATCH:       DEC   D           ;BATCH MODE
ECF4    CA EC5F                      JP    Z,XLIST     ;USE LST: DEVICE FOR
                                                       ;OUTPUT
ECF7    14                           INC   D
ECF8    C3 EC51                      JP    XRDR2       ;USE RDR: DEVICE FOR
                                                       ;INPUT & STATUS


            ROM ROUTINES CALLED BY BIOS

5FE6        SERO    EQU     5FE6H       ;SERIAL OUTPUT CHAR IN A
5FE9        SERI    EQU     SERO+3      ;SERIAL INPUT INTO A
5FEC        SERPS   EQU     SERO+6      ;SERIAL PRINTER STATUS CHECK
5FEF        SERPO   EQU     SERO+9      ;SERIAL PRINTER OUTPUT IN C
5FF2        PARPS   EQU     SERO+12     ;PARALLEL PRINTER STATUS
5FF5        PARPO   EQU     SERO+15     ;PARALLEL PRINTER OUTPUT C
```