NCR DECISION MATE V
SYSTEM TECHNICAL MANUALS

System Technical Manual
Hardware

System Technical Manual
CP/M® -80

System Technical Manual
MS™ -DOS

System Technical Manual
CP/M® -86

In the NCR DECISION MATE V System Technical Manual series, the chapters are arranged in numeric sequence and the appendices in alphabetic sequence:

Hardware — Chapters 1 and 2, Appendix A

CP/M-80 — Chapter 3, Appendix B

MS-DOS — Chapter 4, Appendix C

CP/M-86 — Chapter 5, Appendix D

FOREWORD

The NCR DECISION MATE V System Technical Manuals are designed to provide both hardware and software information: they are intended for designers, system integrators, programmers, and other interested persons who require detailed information on the construction and operation of the NCR DECISION MATE V.

Problems arising from any changes that you make to the hardware or software of the NCR DECISION MATE V are your responsibility. NCR cannot assist in resolving problems that may arise when making changes to the hardware or software.

The first manual provides general information on the NCR DECISION MATE V and its various options. Information is included on how to identify the various models and kits that are available. The hardware description includes information about the I/O bus, signal levels, power requirements, and plug/pin assignments.

The other manuals provide information on the various operating system software used with the NCR DECISION MATE V. The software descriptions include information for using system routines at machine code level.

The appendices provide schematics, component locations, software listings, and other information that may be helpful to the user of these manuals.

NCR DECISION MATE V
SYSTEM TECHNICAL MANUAL
CP/M-80

CONTENTS

CP/M-80 SOFTWARE FOR INPUT/OUTPUT

CP/M-80™ Software consists of a collection of file processing utility programs, an assembler for the conversion of mnemonic assembler language into machine code, and a debugging tool with which programs can be run and tested at machine code level. CP/M is described as an "operating system" as it provides the framework in which the user can write, store, and run programs.

Essential to any operating system software is the provision of communication facilities between CPU, memory, keyboard, CRT, and/or print-list device. It is also desirable to provide interfaces to additional peripheral devices and to facilitate DMA. CP/M fulfils all these functions.

Typically, CP/M is present on a flexible disk. As soon as the above-mentioned basic functions are present in memory, individual CP/M utilities can be loaded into memory and, when these utilities are no longer required, other CP/M utilities or user programs can take their place. Because CP/M does not execute from ROM but from read/write memory, it is possible to accommodate operating system variables within the system functions with which they are most immediately concerned.

CP/M regards the memory as four distinct areas, as shown in Figure 3.1.

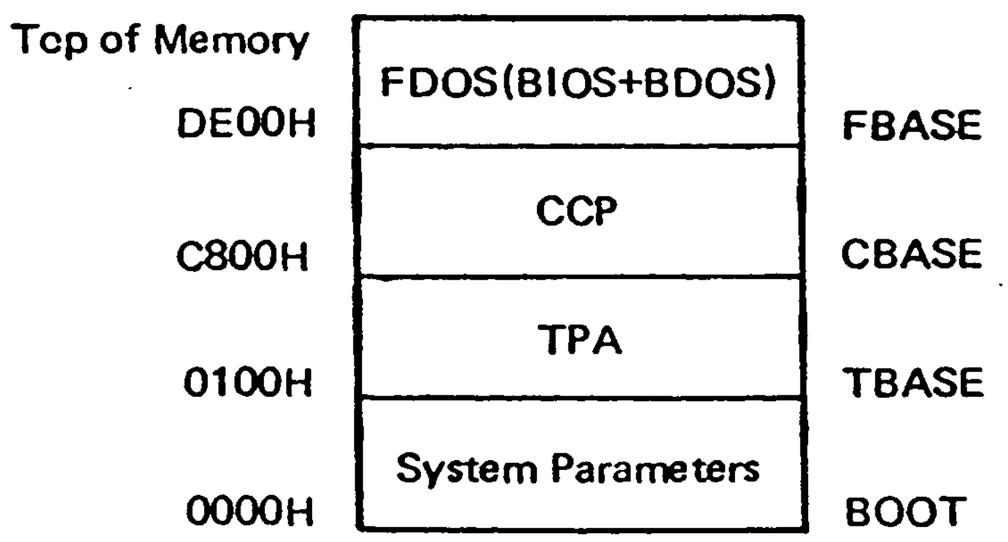


Figure 3.1

At cold start the first sector on the flexible disk (Track 0, Sector 1) loads. The BOOT program from this sector then loads the BIOS to top of memory. The BDOS and CCP are loaded into

the memory area immediately below the BIOS. All these communication functions of the system software are present on the first three tracks of the CP/M flexible disk, as summarized in Figure 3.2.

Function	Disk Sectors
BOOT	Track 0 : Sector 1
BIOS	Track 0 : Sector 2 through Track 1 : Sector 5
CCP	Track 1 : Sector 6 through Track 2 : Sector 1
BDOS	Track 2 : Sector 2 through Track 2 : Sector 8

Figure 3.2

The only additional memory which is required by these system components is the area from address 0 through 0FFH (TBASE). Especially useful addresses in this area are shown in Figure 3.3.

The remaining memory (TPA) is available to CP/M utilities and user programs. Assuming that the BIOS and BDOS areas are not overwritten, it is possible to make use of the CP/M I/O functions in user programs. Overwriting the CCP area does not mean irretrievable loss of system control, as this area is restored following a warm boot (jump to 0000H). In the event of the BIOS or the warm boot jump at 0000H being overwritten, a cold start will be necessary.

Memory Location	Use by CP/M
0000H-0002H	Unconditional jump (Opcode C3) to warm start entry point in BIOS *
0003H	IOBYTE : governs interface to physical devices
0004H	Default drive number (0 = A etc)
0006H-0007H	Address for access to BDOS (FBASE). Machine code instruction "2A0600" returns access address in HL, unless DDT utility is loaded.* Byte 0005 provides the jump instruction to that address.
0008H – 0037H	Interrupt locations 1 through 6, not used, but location 6 to be considered as reserved.
0038H – 003AH	Restart 7: Unconditional jump to DDT, used for breakpoints when DDT is running.
003BH – 003FH	To be considered as reserved.
0040H – 004FH	Scratchpad area, at present not used.
0050H – 005BH	To be considered as reserved.
005CH – 007CH	Default FCB produced for a transient program by the CCP. (See "File information.")
007DH – 007FH	Optional default random record position. (See "File Information.")

* machine addresses are stored with most significant byte nearest to top of memory.

Figure 3.3

LOGICAL DISK LAYOUT

FLEXIBLE DISK (5 1/4-inch)

The drive for flexible disk is designed to make use of double-sided disks with double-density storage of data. Each surface of the flexible disk is considered as consisting of 40 concentric tracks, numbered consecutively 0 through 39. The two surfaces are designated surface 0 and surface 1. The formatting utility included in the CP/M describes the surface 1 tracks with the numbers 40 through 79. This is to facilitate user identification of a faulty

track. The convention of flexible disk description is to designate the tracks on both surfaces 0 through 39. Figure 3.2 has shown that tracks 0, 1, and 2 of surface 0 contain the I/O software. With the exception of track 3, which is reserved for the CP/M directory (128 entries, each 32 bytes), the remaining tracks (surface 0:4 . . . 39, surface 1:0 . . .39) are available for data storage. The spacing on the flexible disk is 48 tracks per inch. Each track is divided into 8 equal length sectors. Each sector is further divided into an address area and a data area.

The following is a description of the logical layout and formatting requirements for flexible disks being used in the CP/M operating system. Figure 3.4 presents the corresponding schematic layout. Certain elements of formatting on the flexible disk are fixed and invariable. This applies in particular to the address area (surface number, track number, etc.). However, the flexible disk has not been initialized at manufacture with this information. It is the user's responsibility to include this information in the initialization process. If you wish, the FORMAT utility will do this for you.

NOTE: With regard to hexadecimal values in the following description, the most significant bit (Bit 7) in each byte is recorded first.

Gap 4

This presents a filler immediately prior to the physical index hole. This gap is filled with bytes of hexadecimal 4E. The number of these bytes can vary, but a typical number is 873.

Gap 1

Immediately following the index hole: 80 bytes of 4E, then 12 bytes of zero, 3 bytes of hexadecimal C2, then FC, then 50 bytes of 4E. This gap and Gap 4 serve to compensate for timing variations due mainly to rotational speed.

Sync Field

12 bytes of zero to resynchronize the PLO (phase locked oscillator) after encountering timing discrepancies resulting from in-place updates or re-initialization.

AM (Address Marker)

3 bytes of hexadecimal A1 followed by FE. The A1 bytes have a missing clock transition between bits 2 and 3. (Both these bits and the bit immediately above and below these bits are reset, i.e. value 0.) AM indicates that address information follows.

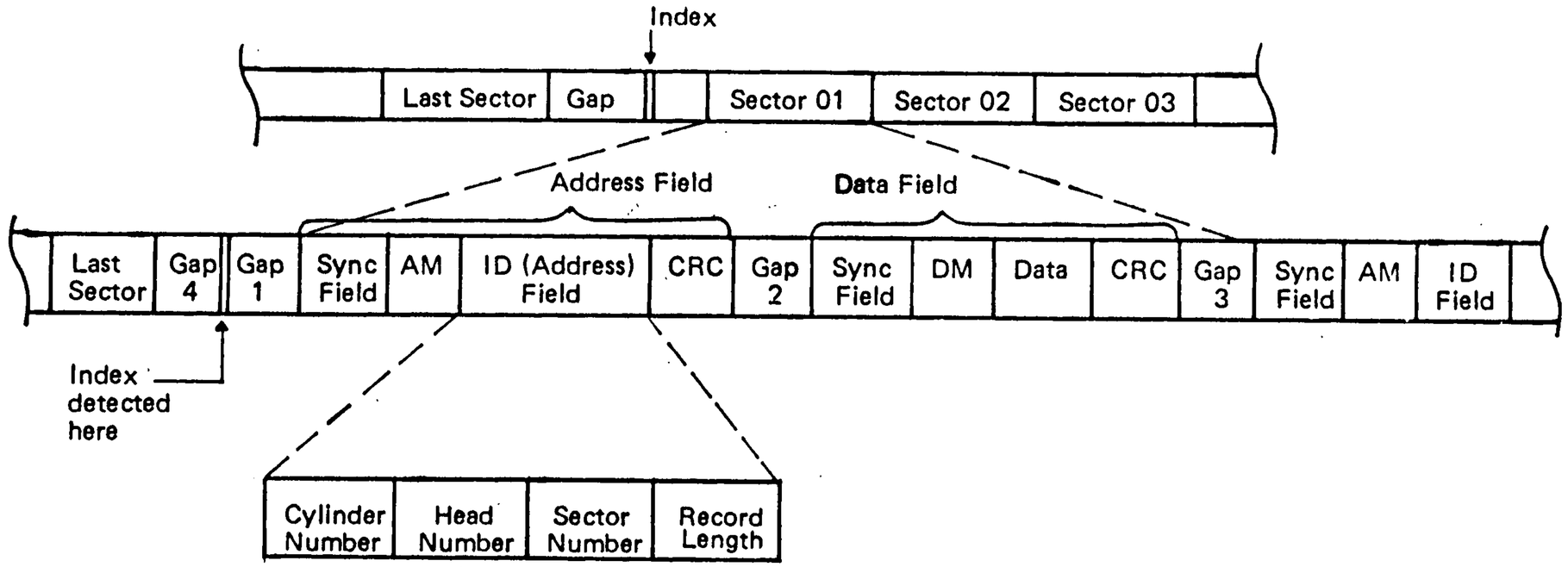


Figure 3.4

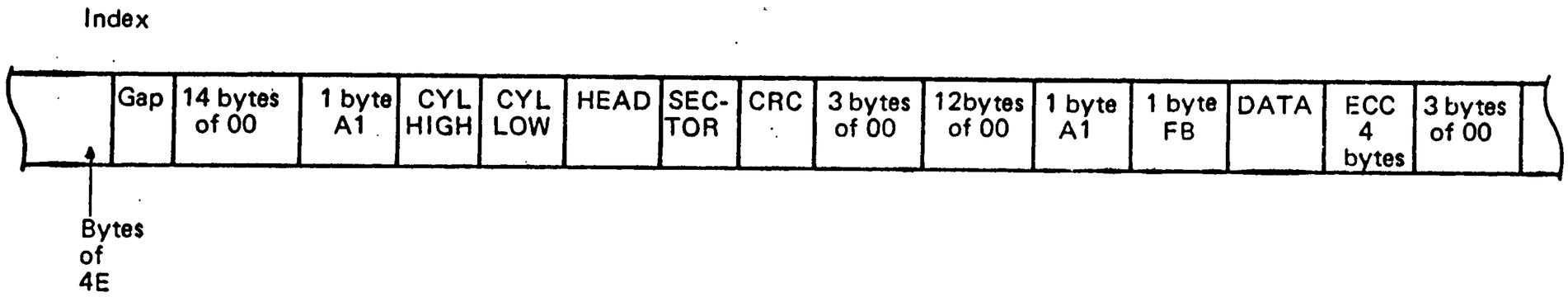


Figure 3.5

DM (Data Marker)

As with AM, except that FB follows the A1 bytes. DM indicates that data follows.

CM (Control Marker)

3 bytes of hexadecimal C2 followed by FC. The C2 bytes have a missing clock transition between bits 3 and 4. (Both these bits and the bit immediately above and below these bits are reset, i.e. value 0.) CM indicates that control information follows.

ID (Address) Field

The 4 bytes following the address marker (AM) must contain the following information:

Byte 1 Track (cylinder) number zero through 27H.
Byte 2 Surface (head) number: 00 = surface 0, 01 = surface 1.
Byte 3 Sector number 01 through 08.
Byte 4 Physical record length: 02 indicates 512 bytes per sector.

Data

The 512 bytes following the data marker (DM) are available for data storage.

CRC (Cyclic Redundancy Check)

Polynomial codes are recorded in 2 bytes at the end of each address or data area for error checking purposes.

In the case of an address area, the CRC value is computed using the preceding 8 characters (i.e. A1, A1, A1, FE, and the 4 address bytes).

For a data area, the preceding 516 bytes are used (i.e. A1, A1, A1, FB, and the 512 data bytes).

Gap 2

22 bytes of hexadecimal 4E immediately following the address CRC.

Gap 3

80 bytes of hexadecimal 4E immediately following the data CRC.

The obligatory 6-byte disk identifier ("NCR F3") is contained at offset 10 on surface 0, track 0, sector 1.

WINCHESTER DISK

The Winchester disk software format is similar to that of the flexible drive, in that an index mark is recognized (a pulse of at least

200nS) followed by ID and Data Fields, including check bytes. Figure 3.5 shows this layout.

Gap
    30 bytes of 4E for a sector length of 512 bytes.
CYL HIGH
    Value FF: cylinders 256 to 511
    Value FE: cylinders 0 to 255
    Value FD: cylinders 768 to 1023
    Value FC: cylinders 512 to 767

HEAD
    Bit 7 set indicates a bad block
Bytes of 4E
    A typical number of these bytes is 304 at 3600 r.p.m.

I/O FUNCTIONS

CP/M provides software control over the following I/O and system functions:

- RAM integrity check
- System reset
- Disk drive selection
- Set disk status
- Search for and access disk files
- Create and restore disk files
- Disk drive motor and head travel
- Reader Input and Punch Output
- Console I/O
- Keyboard code translation
- Set function keys
- List Output
- Serial and parallel I/O
- DMA
- Drive loudspeaker
- Display error messages

When BIOS (with BDOS) has loaded, the software which executes these functions is available from FBASE upwards. There is, however, one exception: the RAM integrity check routine along with the copyright message on the CRT (approximately 390 bytes) are overwritten as soon as the check has been passed.

BDOS ENTRY FUNCTIONS

Important I/O functions can be accessed through a machine call instruction to the address 0005H in page zero of the memory. This, in turn effects a jump to BDOS, and from there to the specified function within the I/O memory area. Before the call is made to page zero, certain CPU registers have to be loaded in accordance with the I/O function to be carried out. Certain functions return a result value in A (one-byte result) or HL (two-byte result). Figure 3.6 explains briefly the nature of each function, the function number which must be loaded in Register C, additional entry parameters and their required registers, as well as the significance of any return value. The advantage for programmers of using these entry points is that their validity is less likely to be impaired by future BIOS developments.

Function no. in Reg. C (Hex)	Description	Additional Entry Parameters	Return Value
00	System reset.	—	—
01	Console input — waits for character, which is echoed to console.	—	Reg. A: ASCII character
02	Console output — tabs expanded, print control chars. recognized.	Reg. E: ASCII character	—
03	Reader input — waits for character	—	Reg. A: ASCII character
04	Punch output.	Reg. E: ASCII character	—
05	List output.	Reg. E: ASCII character	—
06	Direct console I/O — in contrast to 01, control characters are ignored.	Reg. E: 0FFH	Reg. A: ASCII character from console, 00H if none ready
		Reg. E: <> 0FFH	console: contents of Reg. E
07	Get I/O Byte.	—	Reg. A: IOBYTE
08	Set I/O Byte.	Reg. E: IOBYTE	—

Figure 3.6 (1 of 4)

Function no. in Reg. C (Hex)	Description	Additional Entry Parameters	Return Value
09	Print string until $ encountered — tabs and control chars. as in 02.	Reg. DE: String address	—
0A	Read console buffer — reads console input into buffer at address DE until CR (0DH) or LF (0AH) or overflow. Other control chars. recognized.	Reg. DE: Buffer address (DE+0): Buffer length	(DE+1) number of characters in buffer
0B	Get console status.	—	Reg. A: <> 0 if char. ready, otherwise 0
0C	Return version number.	—	Reg. H: 0 = CP/M, 1 = MP/M Reg. L: 0 = version before 2.0, lower nibble = release 2.n
0D	Reset disk system — all disks read/write, disk A selected, default DMA address = 80H.	—	—
0E	Select default disk.	Reg. E: Drive A = 0 .. Drive P = 0FH	—
0F	Open existing file — if found, directory information copied to FCB.	Reg. DE: FCB address	Reg. A: 0,1,2, or 3 = found, otherwise 0FFH.
10	Close existing file — new FCB recorded in disk directory.	Reg. DE: FCB address	Reg. A: 0,1,2, or 3 = old directory entry found, otherwise 0FFH
11	Search for first file entry in directory corresponding to FCB.	Reg. DE: FCB address	Reg. A: 0,1,2, or 3 = found, otherwise 0FFH
12	Search for next file entry after last matched entry.	—	Reg. A: 0,1,2, or 3 = found, otherwise 0FFH
13	Delete file matching FCB.	Reg. DE: FCB address	Reg A: 0,1,2, or 3 = found, otherwise 0FFH

Figure 3.6 (2 of 4)

Function no. in Reg. C (Hex)	Description	Additional Entry Parameters	Return Value
14	Read next record of opened file (function 0F or 16) to DMA address (function 1A).	Reg. DE: FCB address	Reg. A: 0 = read successful, otherwise no data at record position
15	Write next record of opened file (function 0F or 16) from DMA address (function 1A).	Reg. DE: FCB address	Reg. A: 0 = write successful, otherwise disk full
16	Make file which does not already exist.	Reg. DE: FCB address	0,1,2, or 3 = successful, 0FFH = no directory space
17	Rename file.	Reg. DE: address of FCB inc. old name. (DE+10H): new name	0,1,2, or 3 = successful, 0FFH = old name not found
18	Drive on line.	—	Reg. HL: bit significance 0...15 corresponds to drive A...P, bit set = drive on line
19	Current default drive.	—	Reg. A: 0...0FH corresponding to drive A...P
1A	Set DMA address — i.e. address of data record for read or write operation. Functions 0,0D, and cold start reset this address to 80H. The first byte is used to hold the number of DMA chars.	Reg. DE: DMA address	—
1B	Get address of drive allocation vector.	—	Reg. HL: address at vector
1C	Temporary disk write protection.	—	—

Figure 3.6 (3 of 4)

Function no. in Reg. C (Hex)	Description	Additional Entry Parameters	Return Value
1D	Get read only vector.	—	Reg. HL: bit significance 0...15 corresponds to drive A...P, bit set = R/O
1E	Set file attributes in directory in accordance with attributes in FCB.	Reg. DE: FCB address	Eeg. A: 0FFH = file named in FCB not found
1F	Get address of disk parameter block		Reg. HL: block address
20	Get/set current user number.	Reg. E: 0FFH	Reg. A: user number
		Reg. E: <> 0FFH	new user number = content of Reg. E
21, 22 23, 24	These functions concern random file access — see next section "File Information."		
25	Reset drives specified in vector.	Reg. DE: bit significance 0...15 corresponds to drive A...P, bit set = drive to be reset	Reg. A: 00H
26, 27	Not in use		
28	Used in random file access — see next section "File Information."		

NOTE: Functions 1C and 20 may not be supported in later CP/M versions.

Figure 3.6 (4 of 4)

FILE INFORMATION

A disk file is identified by the drive select code, the file name, and the file type. The file itself consists of byte by byte information logically divided into lines by the hexadecimal sequence 0DH, 0AH (carriage return, line feed). When reading, CP/M interprets the hexadecimal value 1A as end-of-file except in machine-executable files (e.g. COM). A file is divided into 16 K byte logical extents automatically accessed in both sequential and access modes.

A CP/M utility or user program may make use of the default file control block situated at address 005CH. The basic unit used in the reading and writing of files is the 128-byte record, for which CP/M provides a default location at 0080H. The DMA address automatically points to this location after either of the Page Zero functions 0 and 0D, or after a cold start.

The FCB data area (i.e. from 005CH onwards) uses 33 bytes for sequential, and 35 bytes (i.e. up to and including 007FH) for random file access. The FCB layout is shown in Figure 3.7. The numbers 00 to 35 in the layout denote the offsets of the individual bytes to the FCB beginning.

dr	f1	f2	/ /	f8	t1	t2	t3	ex	s1	s2	rc	d0	/ /	dn	cr	r0	r1	r2
00	01	02	...	08	09	10	11	12	13	14	15	16	...	31	32	33	34	35

Figure 3.7

dr

drive code (0-16)
0 = use default drive for file
1 = auto disk select drive A,
2 = auto disk select drive B.
. . .
16 = auto disk select drive P.

f1. . .f8

Contain the file name in ASCII upper case, with high bit = 0.

t1, t2, t3

Contain the file type in ASCII upper case. The high bits t1' and t2' are used as follows:

t1' = 1: Read/Only file
t2' = 1: SYS file, no DIR list

ex

Contains the current extent number, normally set to 00 by the user, but in range 0-31 during file I/O

s1

Reserved for internal system use.

s2

Reserved for internal system use, set to zero on call to OPEN, MAKE, SEARCH.

rc

Record count for extent "ex," takes on values from 0-127.

d0. . .dn

Reserved for system use.

cr

Current record to read or write in a sequential file operation, normally set to zero by user.

r0, r1, r2

Optional random record number in the range 0-65535, with overflow to r2. r0, r1 constitute a 16-bit value with low byte r0 and high byte r1.

FCBs are stored in a directory area of the disk and are brought into memory by BDOS Function 0F or 16 before file operations can commence. The memory copy of the FCB is updated during file operations and recorded permanently on disk when these operations are concluded (Function 10).

Function 21 has as its entry parameter an FCB address in the register pair HL. A 16-bit value in the bytes r0 (least significant) and r1 indicates the random record to be read. The value of byte r2 must be zero. The file must already have been opened (Function 0F). If the random read is successful, the value of register A is zero and the accessed record is at the current DMA address. If wishing to random read the next extent, the user must increment the record number, as the next read does not do this automatically. This is true also after switching to sequential read for the first read operation. Error codes returned in register A are:

01 or 04 Read attempted beyond last file extent.

06 Read attempted beyond physical end of disk.

Full details of error codes are to be found in the NCR CP/M Manual.

Function 22 is a write-random facility, using data from the current DMA address. The information given above about

Function 21 applies analogously to this function. In addition, error code 05 indicates failure to write due to directory overflow.

Function 23 refers to the FCB addressed by the DE register pair and writes a binary value in the bytes r0 (least significant) and r1 in accordance with the highest record number. (This is not necessarily the actual number of records for files created in the random mode.) If r2 = 01, then the file contains the maximum number of records (65536). This function is useful for appending random files.

Function 24 is used to set a random record number in bytes r0 and r1 of the FCB addressed by the DE register pair. This FCB usually belongs to a file which has hitherto been accessed sequentially. This is useful when changing the access mode from sequential to random, or for noting the position of a record in a sequential file.

DISK INFORMATION

Tables are included in the BIOS that describe the particular characteristics of the disk subsystem used with CP/M. The purpose here is to describe the elements of these tables.

In general, each disk drive has an associated (16-byte) disk parameter header that contains information about the disk drive and provides a scratchpad area for certain BDOS operations. The format of the disk parameter header for each drive is shown below.

Disk Parameter Header

XLT	0000	0000	0000	DIRBUF	DPB	CSV	ALV
16b	16b	16b	16b	16b	16b	16b	16b

where each element is a 16-bit value. The meaning of each Disk Parameter Header (DPH) element is:

XLT
: Always 0000H because no sector translation takes place (i.e. the physical and logical sector numbers are the same).

0000
: Scratchpad values for use within the BDOS (initial value is unimportant).

DIRBUF
: Address of a 128-byte scratchpad area for directory operations within BDOS. All DPHs address the same scratchpad area.

DPB
: Address of a disk parameter block for this drive. Drives with identical disk characteristics address the same disk parameter block.

CSV
: Address of a scratchpad area used for software check for changed disks. This address is different for each DPH.

ALV
: Address of a scratchpad area used by the BDOS to keep disk storage allocation information. This address is different for each DPH.

Given n disk drives, the DPHs are arranged in a table whose first row of 16 bytes corresponds to drive 0, with the last row corresponding to drive n-1. The table thus appears as

```
DPBASE:

00   XLT 00 0000 0000 0000 DIRBUF DBP 00 CSV 00  ALV 00
01   XLT 01 0000 0000 0000 DIRBUF DBP 01 CSV 01  ALV 01
                  and so on through
n-1  XLTn-1 0000 0000 0000 DIRBUF DBPn-1 CSVn-1  ALVn-1
```

where the label DPBASE defines the base address of the DPH table.

A responsibility of the SELDSK subroutine (see "The BIOS Entry Points") is to return the base address of the DPH for the selected drive. The Disk Parameter Block (DPB) for each drive is more complex. A particular DPB, which is addressed by one or more DPHs, takes the general form

```
SPT  BSH  BLM  EXM  DSM  DRM  AL0  AL1  CKS  OFF
16b  8b   8b   8b   16b  16b  8b   8b   16b  16b
```

where each is a byte or word value, as shown by the 8b or 16b indicator below the field.

SPT
: The total number of sectors per track.

BSH

The data allocation block shift factor, determined by the data block allocation size. (BSH has for flexible disk a value of 4, for fixed disk a value of 6).

BLM

The data allocation block mask (2**BSH-1). (BLM has for flexible disk a value of F, for fixed disk a value of 3F).

EXM

The extent mask, determined by the data block allocation size and the number of disk blocks.

DSM

Determines the total storage capacity of the disk drive.

DRM

Determines the total number of directory entries that can be stored on this drive. (AL0, AL1 determine reserved directory blocks.)

CKS

The size of the directory check vector.

OFF

The number of reserved tracks at the beginning of the (logical) disk.

The value of DSM is the maximum data block number supported by this particular drive, measured in BLS (BLS = 2048 bytes) units. The product BLS times (DSM+1) is the total number of bytes held by the drive, not counting the reserved operating system tracks.

The DRM entry is the one less than the total number of directory entries that can take on a 16-bit value. The values of AL0 and AL1, however, are determined by DRM. The values AL0 and AL1 can together be considered a string of 16 bits, as shown below.

AL0								AL1							
00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15

where position 00 corresponds to the high order bit of the byte labeled AL0, and 15 corresponds to the low order bit of the byte labeled AL1. Each bit position reserves a data block for number of directory entries, thus allowing a total of 16 data blocks to be assigned for directory entries (bits are assigned starting at 00 and filled to the right until position 15). Each directory entry occupies 32 bytes, resulting in the following tabulation.

BLS	Directory Entry
2048	64 times # bits

Thus, if DRM = 127 (128 directory entries) and BLS = 2048, there are 64 directory entries per block, requiring 2 reserved blocks. In this case, the 2 high order bits of AL0 are set, resulting in the values AL0 = 0C0H and AL1 = 00H.

The CKS value is determined as follows: if the disk drive media is removable, then CKS = (DRM+1)/4, where DRM is the last directory entry number.

Finally, the OFF field determines the number of tracks that are skipped at the beginning of the physical disk (reserved operating system tracks). This value is automatically added whenever SETTRK (see section "The BIOS Entry Points") is called.

Returning back to the DPH for a particular drive, the two address values CSV and ALV remain. Both addresses reference an area of uninitialized memory following the BIOS. The areas must be unique for each drive, and the size of each area is determined by the values in the DPB.

The size of the area addressed by CSV is CKS bytes, which is sufficient to hold the directory check information for this particular drive. If CKS = (DRM+1)/4, one must reserve (DRM+1)/4 bytes for directory check use. If CKS = 0, no storage is reserved.

The size of the area addressed by ALV is determined by the maximum number of data blocks allowed for this particular disk and is computed as (DSM/8)+1.

LOGICAL ASSIGNMENT OF I/O DEVICES

CP/M makes use of four types of communication channel:

CONSOLE
: Interactive communication with the operator.

LIST
: Output channel to the principle listing device, usually a printer.

PUNCH
: Punching device.

READER
: Reading device.

Each of a number of physical devices is assigned to one or more of these logical devices. The physical devices are TTY (serial printer device), CRT, LPT (parallel printer). Figure 3.8 shows the possible bit settings within the IOBYTE at address 0003H, which can be carried out by the BDOS Function 08. The Console field occupies bits 0 and 1 of the IOBYTE, the Reader field occupies bits 2 and 3, the Punch field bits 4 and 5, and the List field bits 6 and 7.

Console assigned to . . .	Binary value of bits 0 with 1
TTY	0 or 3
CRT	1 or 2

Figure 3.8 (1 of 4)

Reader assigned to . . .	Binary value of bits 2 with 3
TTY	0 or 3
CRT	1 or 2

Figure 3.8 (2 of 4)

Punch assigned to . . .	Binary value of bits 4 with 5
TTY	0
CRT	1 or 3
LPT	2

Figure 3.8 (3 of 8)

List assigned to . . .	Binary value of bits 6 with 7
TTY	0 or 3
CRT	1
LPT	2

Figure 3.8 (4 of 4)

TERMINAL FUNCTIONS

This section concerns the possibilities of software manipulation of the CRT display. CP/M recognizes a number of codes up to three bytes in length which are applicable to cursor movement, partial or whole screen clearance, variation of CRT intensity, and activating the loudspeaker. One or more functions are possibly not implemented on some machines. Figure 3.9 summarizes the function codes. With reference to this figure, it must be appreciated that functions cannot be attributed to specific keys on the keyboard. This is because there is a wide variety of keyboards available for different parts of the world. By checking in the relevant column for a particular keyboard in the chapter "Keyboard Codes" in the Hardware Description, it is, however, possible to find the key for a particular function.

The function codes are the same as those used by the Lear Siegler ADM-31™ terminal, with the following exceptions: 17H (Clear to End of Line) and 1BH 4DH (Play Music) are implemented in your NCR DECISION MATE V. The Lear Siegler ADM-3A™ terminal uses the functions which do not commence with 1BH (exception: 17H — Clear to End of Line).

The frequencies produced by the Play Music function are shown in Figure 3.10.

TERMINAL FUNCTION CODES	
Function	**Hexadecimal Code**
POSITION CURSOR ROW + Offset COL + Offset	1B 3D followed by ROW + 20 followed by COL + 20
CURSOR LEFT (non-destructive backspace)	08
CURSOR DOWN (line feed)	0A
CURSOR RIGHT (non-destructive forward space)	0C
CURSOR UP (reverse line feed)	0B
CURSOR HOME (top left corner)	1E
CLEAR SCREEN and CURSOR HOME	1A or 1B 2A or 1B 3A
CLEAR TO END OF LINE	17 or 1B 54 or 1B 74
CLEAR TO END OF SCREEN	1B 59 or 1B 79
CARRIAGE RETURN	0D
ESCAPE	1B
INSERT LINE	1B 45
INSERT CHARACTER	1B 51
DELETE LINE	1B 52
DELETE CHARACTER	1B 57
HALF INTENSITY OFF	1B 28
HALF INTENSITY ON (Yellow on color CRT)	1B 29
RESET INVERSE AND BLINKING	1B 47 30
VIDEO INVERSE ON	1B 47 34
BLINKING ON	1B 47 32
RING THE BELL	07
MUSIC	1B 4D followed by Frequency in the range 21 to 4A, or 20 = no tone followed by Length in the range 20 to FF (steps of 20ms)
NOTE: Combination of HALF INTENSITY ON/OFF and VIDEO INVERSE ON/OFF create different foreground/background colors on color CRT.	

Figure 3.9

MUSIC CODES		
NOTE	FREQUENCY	CYCLES
PAUSE	20	—
A	21	110
A#	22	116.5
B	23	123.5
C	24	131
C#	25	138.6
D	26	146.8
D#	27	155.8
E	28	164.8
F	29	174.6
F#	2A	185
G	2B	196
G#	2C	208
A	2D	220
A#	2E	233
B	2F	246.9
C (Middle C)	30	261.6
C#	31	277.4
D	32	293.7
D#	33	311
E	34	329.6
F	35	349.2
F#	36	370
G	37	392
G#	38	415
A	39	440
A#	3A	465
B	3B	493.9
C	3C	523.2
C#	3D	553
D	3E	587.3
D#	3F	622
E	40	659.3
F	41	698.5
F#	42	740
G	43	784
G#	44	830
A	45	880
A#	46	932
B	47	987.8
C	48	1046.5
C#	49	1108.7
D	4A	1174.7

Figure 3.10

It is possible to program the Function Keys (F1 . . . F20) of your keyboard by use of the following hexadecimal sequence:

1B
46
Function number, using the appropriate value E0 (Function 0) . . . F3 (Function 20)
New function: a string of values 0 . . . 7F, including control characters except 09.
Function number, as above.

For example, the following hexadecimal sequence sets F2 to the function DIR with a concluding carriage return:

1B 46 E1 44 49 52 0D E1

The advantage to the programmer of this method is that there is no need to return to CP/M-80 system level in order to program a Function Key via the CONFIG utility.

THE BIOS PROGRAM

In the Appendix B of this guide you will find the listing of the Basic Input/Output System in Intel® 8080 assembly language. Before attempting to study this listing, it is, however, advisable tc read the following two sections with regard to the addresses produced in this assembly.

HOW TO READ THE BIOS PROGRAM

The assembly listing has been produced on the basis of six logically separable aspects of the BIOS software which have been entitled MBIOS, NBIOS, OBIOS, RBIOS, PBIOS and QBIOS. Preceding each of these sections of assembly instructions are lists of the equates relating to the use of constants and symbolic addresses. For example, the symbol for the function code used to clear the screen is "CLRSCN." Under "Control Character Equates" on page 7 (page number appears as three digits at the top of the page) in MBIOS, you will find in line 175 that the actual hex value for this symbolic constant which is to be created at the time of the assembly is 1A. (Compare this value with the appropriate entry in Figure 3.9!). Therefore, the byte definition "DB CLRSCN" in line 307 is effected using the value 1A. An example of a symbolic address equate is present on page 3 in line 73, where "NCON-

OUT," the address of the routine which displays a character on the screen, is given the value "STBIOS+12." Line 72 already tells us that STBIOS has the hex value DE00. Therefore, in line 342 (page 14) the assembler replaces "NCONOUT" with the hex value DE0C. (The value 12 without the suffix "H" in line 73 is regarded by the assembler as a decimal and not a hexadecimal number.)

It will have become apparent from reading the assembler instructions used in these examples (lines 307 and 342), that the following format is used:

```
hhhh  object code  label: (if any)  instruction  ; comment (if
                                                        any)
```

where hhhh represents the hexadecimal address relative to the beginning of the assembly section, the object code is the hex code produced by the assembler, label is a symbolic address, and the instruction is derived from Intel 8080 assembly language. An example where all these components are present is line 183 (the beginning of MBIOS):

```
0000 C32100 BEGIN: JMP BMOVE  ; jump move routine
```

At assembly, the symbolic address was interpreted as 0021, i.e. 33 bytes higher in memory than the beginning of this assembly section. Note that addresses in object code are assembled with their two bytes "in reverse order," that is, the most significant byte of the two has the higher address. For a detailed summary of 8080 assembly language, the user should refer to the NCR CP/M manual. (The fact that the CPU in your machine is a Z-80® microprocessor is of no detriment to the use of 8080 assembly language in the CP/M "ASM" and "DDT" utilities.)

In the examples we have seen so far, it is evident that the assembler had already been provided with a value to use in place of the symbol in the generation of the object code. There are, however, occasions when an assembler cannot replace the symbol at the time of producing a listing such as this one. Instead, the listing shows a zero value in one or two bytes, according to the type of assembly instruction. The circumstances in which a zero value is listed in place of a symbol, is where the symbol definition occurs externally to the section being assembled. An example of this can be found in NBIOS in line 1144 (page 33). Note that the assembler has entered a zero value in two bytes instead of the address "READOP," and that the list of symbols similarly shows

a zero value for this symbol (page 54). To avoid an error code of unresolved symbol, the assembler had to be told that "READOP" is an "external definition" (page 3). "READOP" appears with an actual value for the first time in OBIOS (see symbol list on OBIOS page 43). It would be tedious to have to check through a number of lists to find this actual value. For this reason, the BIOS link-list is included (Appendix B) immediately following the BIOS listing. This is the list of external definitions which were finally resolved when the sections of BIOS were put together.

Symbolic references within individual sections, including forward references, could be resolved before the assembler produced the listing.

The equate (EQU) statements at the front of each BIOS section give information regarding the use within the program of particular symbols. In addition, the list of symbols following each BIOS section provides the resolution of each non-external symbol. In these lists you will also find the line number of each occurrence of a symbol.

It is important to remember that the BIOS program is hardware related, and that variations in the hardware between models mean that there are different versions of BIOS. For example, the BIOS must carry out slightly different functions in a system with fixed disk drives to those required in a system which uses only flexible disks; a color CRT requires more extensive drive parameters than a monochrome tube. For this reason, the use of absolute machine addresses has been kept to a minimum in the BIOS listing. The reader will note that the starting address of the BIOS in memory is given as hexadecimal DE00. This is the address at which NBIOS is loaded from flexible disk. The remaining sections OBIOS, RBIOS, PBIOS and QBIOS, are loaded after NBIOS concatenated in that order. This means that a hardware determined variation in NBIOS could change the starting addresses of all the other BIOS sections. The following section "Displaying the BIOS Program on the Screen" gives the user useful instructions on how to work with the addresses in the BIOS listing. MBIOS is present in memory only during power-up initialization and is subsequently overwritten by NBIOS.

DISPLAYING THE BIOS PROGRAM ON THE SCREEN

The user can display the BIOS program on the CRT by making use of the Dynamic Debugging Tool utility (DDT) which is provided as part of the CP/M operating system. A full description of DDT is contained in the NCR CP/M manual. It suffices here to say that with the aid of DDT, the user can enter instructions in assembly

language, produce a hexadecimal display of memory on the screen, initialize areas of memory, list the contents of memory in assembly language, transfer the contents of one area of memory to another, load disk files into memory, change the content of memory, and execute programs with or without display of CPU registers. The two DDT commands which are of interest here are the display of memory (D), and assembly language listing (L). As BIOS is already present in memory from FBASE upwards, it is only necessary to load the DDT utilitiy.

The first thing the user can check is the starting address of BIOS. CP/M has made this check easy by recording this address in page zero of the memory in bytes 0001H and 0002H. (Remember: Byte 0002H is the most significant byte of the address.) With DDT loaded, the user can enter D0 or L0. The former will produce lines, each of 16 bytes of memory. The latter will disassemble memory into 8080 assembly language. Assuming that the BIOS actually begins at DE00, byte 0001H contains the value 03, while byte 0002H contains the value DE. To obtain the BIOS starting address, the value 3 must be subtracted from the address contained in these two bytes. To check the starting addresses of this and other BIOS sections, the user can refer to the link-list, where these addresses are resolved, and observe the instructions starting at each address.

An important note is justified here concerning the use of the L command in DDT. The disassembler interprets memory as assembler *instructions*. This means that areas of data storage created by the assembler directives DB, DW, or DS, or memory areas which simply are not used by the BIOS program, can lead to incorrect disassembly. Therefore, the user should ascertain that memory being disassembled contains only valid assembler instructions. (Already bytes 0003H and 0004H are data and not instruction bytes.) The disassembler does not provide symbols.

THE BIOS ENTRY POINTS

The section "BDOS Entry Functions" demonstrated the range of I/O functions which can be used by loading the C and other registers with entry parameters and calling address 0005H. The BIOS in upper memory includes a similar vector, from which I/O functions can be activated by means of a programmed call to one of twenty-one addresses in this vector. A description of these functions follows. The hexadecimal numbers in parentheses represent the positive offset (to the BIOS starting point) of the first byte of the jump instruction which activates that function (see NBIOS, page 10).

CBOOT
(0000) DE58

Cold start initialization.

WBOOT
(0003) DE6B

Warm start — BIOS is not reloaded.

CONST
(0006) EB59

Console status — returns 0FFH in register A if character is ready, otherwise zero.

CONIN EB73
(0009)

Console character returned in register A. Bit 7 is reset. No return until a character is typed.

CONOUT EB8D
(000C)

Contents of register C is sent to the console device.

LIST EBCC
(000F)

Contents of register C is sent to the current listing device. (See section "Logical Assignment of I/O Devices.")

PUNCH
(0012)

Contents of register C is sent to the currently assigned punch device. (See section "Logical Assignment of I/O Devices.")

READER
(0015)

Reader character returned in register A. Bit 7 is reset. (See section "Logical Assignment of I/O Devices.")

HOME
(0018)
Disk head moves to track zero position.
SELDSK
(001B)
Selects disk drive according to contents of register C:
0 = drive A . . . 3 = drive D. Register HL returns the address of the Disk Parameter Header (see section "Disk Information"), or zero if the drive does not exist.
SETTRK
(001E)
Selects track number contained in registers BC.
SETSEC
(0021)
Selects sector number contained in registers BC.
SETDMA
(0024)
Sets DMA address to contents of BC registers. (Register B must contain the most significant byte of this address.)
The automatic warm boot setting is 0080H.
READ
(0027)
Using the set drive, track, sector, and DMA address, one disk sector is read. Normally, register A returns zero. An error will return the value 1 and an error message. Thereupon CR will ignore the error, CONTROL-C will abort.
WRITE
(002A)
Disk sector is written. Settings and returns as in READ.
LISTST
(002D)
Returns status of list device: 0FFH in register A indicates that the device is ready to receive a character.
Useful for background printing.
SECTRAN
(0030)
Moves sector number in BC to HL.
SPECFUN
(0033)
Set up parameters for BIOS functions (see NBIOS, page 16).
Non-standard BIOS function.

SELTYP
(0036)
Returns parameters for EXCHANGE utility (see NBIOS, page 47). Non-standard BIOS function.
DISPERO
(0039)
Displays error message. Non-standard BIOS function.
CLRLI1
(003C)
Clears error line. Non-standard BIOS function.

THE BIOS SECTIONS

This section presents a summary of contents of the BIOS listing. Numbers in parentheses refer to pages within the relevant section (M, N, O, P, Q, or R) of the BIOS. The subsequent section "Making Use of the I/O Functions" will present examples of how to make use of the BIOS.

MBIOS:
RAM integrity check and display of error if occurring. Signing on message. Assuming no error occurs, this section is overwritten by NBIOS.
NBIOS:
BDOS initialization (11).
Cold boot and warm boot (12).
Page zero initialization (13).
Disk, track, and sector selection (17-18).
Set DMA address (18).
CONFIG data, including serial interface parameters (23).
Function Key table (24).
Language translation table for the various keyboards (27).
Translation table: key to control character (29).
Data for error messages (30).
Memory addresses for disk information (31).
Read from disk (33, 35ff, 40).
Write to disk, including check for prior allocation (33, 35ff, 40).
Read and write include data transfer to and from host buffer.
Drive selection and disk initialization (39, 41ff).
Parameters for EXCHANGE utility (47).
Data table for different types of disk and deblocking.

OBIOS:

Regulate number of read/write attempts, in accordance with content of retry/restore counters at 020CH and 020DH, relative to the beginning of NBIOS (10).
Disk formatting (12).
Physical read-from and write-to disk (13ff), including check for NCR disk (29) and disk error routine (38).

RBIOS:

Winchester Disk read and write, and status check.

PBIOS:

Keyboard status and input (10).
Punch output, reader input (11).
Scrolling and cursor manipulation (38-54).
Selecting routine according to a control character (26-27, 30-31).
Translation of character in accordance with special keyboard (28).
CRT inversion and intensity (33-35).
Driving the loudspeaker (36-37).
Final output to CRT (55).

QBIOS:

Routines used in acceptance and interpretation of keyboard input (5-10).
Expansion of function keys (11-13).
RS-232 interface: Port addresses (22), status data (22), initialization (23), check printer input status (25), check if printer ready to receive (26), input and output of data (27).
Parallel (Centronics) interface: disable serial interface (29), output character (30), check if printer ready to receive (30).

MAKING USE OF THE I/O SOFTWARE

The CP/M input/output software operates from read/write memory to which the user has full access. Within the limitations indicated in the section "I/O Functions," it is possible to retrieve the system through a programmatic call, even after parts of the I/O system have been overwritten by a user program. Some advanced programmers may wish to adjust parts of BIOS to meet an exceptional requirement. In doing so, the assembler listing contained in the appendix is invaluable. In addition, the programmer can refer to the final part of this section, "Tables-Routines-Ports."

The majority of users wishing to activate I/O functions at machine code level will find the BDOS and BIOS entry points the most convenient modes of access to the I/O functions. You will notice a considerable similarity between the facilities provided by these two modes of access. The most striking difference concerns the handling of console input and string output to the console device. The BDOS function 2 is intended for ASCII printable characters; in addition, scrolling is carried out as well as printer echo, if set. Cursor and CRT control functions, however, require the use of the BIOS function CONIN. The other significant difference is the enhanced console printing facility from BDOS, the string function 9.

Where possible, programs should use the BDOS entry points. These have been provided in CP/M to ensure that your programs will also run with future developments of BIOS software. If BIOS entry points have been used, it is advisable to check the machine address of the BIOS vector before running user programs in an I/O system loaded from a different CP/M flexible disk. The current vector address is hexadecimal DE00.

SOME I/O EXAMPLES

The following examples are designed to give the user an initial introduction to activating I/O functions at machine code level. In particular, this section cannot provide an extensive guide to programming style. The example instructions are given as hexadecimal machine code written to machine address 100H, i.e. starting immediately after Page Zero. The corresponding Intel 8080 and Zilog Z-80 assembly language instructions are also given. The examples can be assembled using the CP/M ASM utility. (This utility understands only 8080 instructions.) Alternatively, the Set function of the DDT utility can be used for direct input in hexadecimal code. This is particularly useful for very short programs. The Z-80 jump relative (JR) and block transfer (LDD, LDDR, LDI, LDIR) instructions are not used in the examples as there are no single instruction equivalents in 8080 assembly language. They would, of course, execute normally if the user were to enter them via the DDT Set function.

Remember to set suitable breakpoints when using DDT for test runs. Otherwise the CPU will attempt to read the bytes following your program as instructions.

CAUTION

For experimenting with the I/O software, it is advisable to use an additional copy of your CP/M flexible disk. In the event of file damage due to the accidental or incorrect activation of a disk file handling routine, a replacement copy can be made using the master flexible disk.

Sound

This example drives the loudspeaker by using the BIOS CONOUT function. The tones produced are an ascending scale. The equate statements:

```
BIOS  EQU  0DE00H      ; BIOS vector
SPEAK EQU  BIOS + 0CH  ; offset in vector of CONOUT jump
```

Addr.	Obj. Code	Label	8080	Z-80	comment
0200			ORG 200H	ORG 200H	
0200	0E1B	ACCEPT:	MVI C,1BH	LD C,1BH	
0202	CD0CDE		CALL SPEAK	CALL SPEAK	
0205	0E4D		MVI C,4DH	LD C,4DH	
0207	CD0CDE		CALL SPEAK	CALL SPEAK	
020A	C9		RET	RET	
			; The above subroutine is used by the following		
			; main routine to tell the console device that the		
			; next two bytes represent frequency and length		
			; (see section "Terminal Functions").		
0100			ORG 100H	ORG 100H	
0100	3E20		MVI A,20H	LD A,20H	; starting fre-
					; quency
0102	3C	SCALE:	INR A	INC A	; next frequency
0103	FE4B		CPI 4BH	CP 4BH	; end of scale?
0105	CA1B01		JZ DONE	JP Z,DONE	; then terminate
0108	F5		PUSH PSW	PUSH AF	
0109	CD0002		CALL ACCEPT	CALL ACCEPT	
010C	F1		POP PSW	POP AF	
010D	4F		MOV C,A	LD C,A	; frequency
010E	F5		PUSH PSW	PUSH AF	
010F	CD0CDE		CALL SPEAK	CALL SPEAK	
0112	0E29		MVI C,29H	LD C,29H	; length 100ms
0114	CD0CDE		CALL SPEAK	CALL SPEAK	; per tone
0117	F1		POP PSW	POP AF	
0118	C30201		JMP SCALE	JP SCALE	
011B	00	DONE:	NOP	NOP	

Invert

This example uses the CONOUT function to invert the CRT display (dark on light background).

The equate statements:

```
BIOS    EQU  0DE00H    ; BIOS vector
CRTOUT  EQU  BIOS+0CH  ; offset in vector of CONOUT jump
CBYTE1  EQU  1BH       ; 3 byte control sequence
CBYTE2  EQU  47H       ; for Video Inverse (see
CBYTE3  EQU  34H       ; "Terminal Functions")
```

Addr.	Obj. Code	Label	8080	Z-80	comment
0100			ORG 100H	ORG 100H	
0100	0E1B		MVI C,CBYTE1	LD C,CBYTE1	
0102	CD0CDE		CALL CRTOUT	CALL CRTOUT	
0105	0E47		MVI C,CBYTE2	LD C,CBYTE2	
0107	CD0CDE		CALL CRTOUT	CALL CRTOUT	
010A	0E34		MVI C,CBYTE3	LD C,CBYTE3	
010C	CD0CDE		CALL CRTOUT	CALL CRTOUT	

Running this routine a second time will reset the CRT display contrast to normal if the value of CBYTE3 is changed to 30H.

Dim

This example sets the CRT writing to half intensity. The equate statements:

```
BIOS    EQU  0DE00H    ; BIOS vector
CRTOUT  EQU  BIOS+0CH  ; offset in vector of CONOUT jump
CBYTE1  EQU  1BH       ; 2 byte control sequence
CBYTE2  EQU  29H       ; for Half Intensity (see "Terminal
                       ; Functions")
```

Addr.	Obj. Code	Label	8080	Z-80	comment
0100			ORG 100	ORG 100	
0100	0E1B		MVI C,CBYTE1	LD C,CBYTE1	
0102	CD0CDE		CALL CRTOUT	CALL CRTOUT	
0105	0E29		MVI C,CBYTE2	LD C,CBYTE2	
0107	CD0CDE		CALL CRTOUT	CALL CRTOUT	

Running this routine a second time will reset the CRT display to normal intensity if the value of CBYTE2 is changed to 28H.

Read Keyboard

This example reads each character as it is typed in from the keyboard and displays that character on the screen. The CONIN function waits each time until a key is pressed. Before the first character is displayed, the screen is cleared and the cursor set top left. If a numeric sign (0. . .9) is entered, inverse video is activated temporarily. The program terminates when a dollar sign ($) is entered, and normal video is restored if necessary.

The equate statements:

```
BIOS    EQU  0DE00H    ; BIOS vector
INKEY   EQU  BIOS+9    ; offset in vector of CONIN jump
CRTOUT  EQU  BIOS+0CH  ; offset in vector of CONOUT jump
CBYTE1  EQU  1BH       ; 1st byte of control sequence
CBYTEX  EQU  3AH       ; clear screen and cursor home
CBYTE2  EQU  47H       ; 2nd byte of control sequence
CBYTEI  EQU  34H       ; used for inverse
CBYTER  EQU  30H       ; used for reset inverse
ZERO    EQU  '0'
NINE    EQU  '9'
EOTEXT  EQU  '$'       ; end of text sign
```

Addr.	Obj. Code	Label	8080	Z-80	comment
0200			ORG 200H	ORG 200H	
0200	0E1B	INVERS:	MVI C,CBYTE1	LD C,CBYTE1	; produces
0202	CD0CDE		CALL CRTOUT	CALL CRTOUT	; inverse video
0205	0E47		MVI C,CBYTE2	LD C,CBYTE2	
0207	CD0CDE		CALL CRTOUT	CALL CRTOUT	
020A	0E34		MVI C,CBYTEI	LD C,CBYTEI	
020C	CD0CDE		CALL CRTOUT	CALL CRTOUT	
020F	C9		RET	RET	
0210	0E1B	REVERS:	MVI C,CBYTE1	LD C,CBYTE1	; reverts to
0212	CD0CDE		CALL CRTOUT	CALL CRTOUT	; normal video
0215	0E47		MVI C,CBYTE2	LD C,CBYTE2	
0217	CD0CDE		CALL CRTOUT	CALL CRTOUT	
021A	0E30		MVI C,CBYTER	LD C,CBYTER	
021C	CD0CDE		CALL CRTOUT	CALL CRTOUT	
021F	C9		RET	RET	
0220	0E1B	CLSCRN:	MVI C,CBYTE1	LD C,CBYTE1	; two control
0222	CD0CDE		CALL CRTOUT	CALL CRTOUT	; characters for
0225	0E2A		MVI C,CBYTEX	LD C,CBYTEX	; clear screen
0227	CD0CDE		CALL CRTOUT	CALL CRTOUT	; and cursor
022A	C9		RET	RET	; h

```
Addr.  Obj. Code      Label    8080            Z-80            comment

0100                           ORG 100H        ORG 100H
0100   CD2002                  CALL CLSCRN     CALL CLSCRN
0103   CD1002          NEXT:   CALL REVERS     CALL REVERS     ; normal video
0106   CD09DE                  CALL INKEY      CALL INKEY      ; read key
0109   FE24                    CPI EOTEXT      CP EOTEXT       ; $?
010B   CA2701                  JZ DONE         JP Z,DONE       ; then end
010E   FE30                    CPI ZERO        CP ZERO         ; if > = 0
0110   DA2001                  JC PRINT        JP C,PRINT      ; and < = 9
0113   FE39                    CPI NINE        CP NINE         ; then inverse
0115   CA1B01                  JZ INVT         JP Z,INVT       ; video
0118   D22001                  JNC PRINT       JP NC,PRINT
011B   F5              INVT:   PUSH PSW        PUSH AF
011C   CD0002                  CALL INVERS     CALL INVERS
011F   F1                      POP PSW         POP PSW
0120   4F              PRINT:  MOV C,A         LD C,A          ; character
0121   CD0CDE                  CALL CRTOUT     CALL CRTOUT     ; on screen
0124   C30301                  JMP NEXT        JP NEXT
0127   00              DONE:   NOP             NOP
```

String

This example displays a character string using the BDOS Function 9. Note that each character is printed until a dollar sign ($) is encountered. The dollar sign itself is not displayed.

The equate statements:

```
PZERO   EQU  0005       ; address of entry point
OUTSTR  EQU  09         ; function number
BIOS    EQU  0DE00H     ; BIOS vector
CRTOUT  EQU  BIOS+0CH   ; BIOS CONOUT jump
STRING  EQU  0200H      ; address of string
CR      EQU  0DH        ; control character
LF      EQU  0AH        ; control character
```

```
Addr.  Obj. Code      Label    8080            Z-80            comment

0200                           ORG 200H        ORG 200H
0200   594F552053              DB 'YOU SEE, THE DOLLAR SIGN DOES NOT
                               APPEAR'
0250                           ORG 250H        ORG 250H
0250   0E0D            CRLF:   MVI C,CR        LD C,CR         ; subroutine for
0252   CD0CDE                  CALL CRTOUT     CALL CRTOUT     ; carriage return
0255   0E0A                    MVI C,LF        LD C,LF         ; and line feed
0257   CD0CDE                  CALL CRTOUT     CALL CRTOUT
025A   C9                      RET             RET
```

```
Addr.  Obj. Code   Label   8080            Z-80            comment

0100               ORG 100H        ORG 100H
0100   CD5002      CALL CRLF       CALL CRLF       ; blank line
0103   110002      LXI D,STRDE     LD HL,STRDE     ; string addr.
                                                   ; in DE
0106   0E09        MVI C,OUTSTR    LD C,OUTSTR
0108   CD0500      CALL PZERO      CALL PZERO
010B   CD5002      CALL CRLF       CALL CRLF       ; blank line
010E   CD5002      CALL CRLF       CALL CRLF
```

Duplicate

This is a sample program which stores keyboard input in memory and duplicates the stored data on the printer as often as you wish. Starting with a clean screen, you can enter data which is echoed to the screen. Carriage Return is recognized and also noted in the storage area, which means that you do not have to fill remaining line space with individual spaces via the keyboard. You may write more than one full screen; normal scrolling will then occur. You may enter very large amounts of data — if this program alone is loaded, you can fill the memory from 300H up to the input/output system (or up to DDT, if you are testing with this utility)!

To terminate data input, enter a dollar sign ($). Your data will now be directed to the printer, recognizing carriage return and line feed as previously entered from the keyboard. When the printer has finished, you need only press R or r for a further print copy. You may repeat this as often as you wish.

This example makes use of Page Zero functions for reading the keyboard, creating backspaces, and final printing. The BIOS entry points are used for screen clearing, screen line feed, and printer line feed.

The equate statements:

```
BIOS    EQU  0DE00H    ; BIOS vector
CRTOUT  EQU  BIOS+0CH  ; BIOS CONOUT jump
BLST    EQU  BIOS+0FH  ; BIOS PRINT jump
CBYTE1  EQU  1BH       ; first byte of control sequence
CBYTEX  EQU  3AH       ; clear screen and cursor home
PZERO   EQU  0005      ; address of entry point
INKEY   EQU  01        ; Page Zero read keyboard
OUTTXT  EQU  02        ; Page Zero character to CRT
CR      EQU  0DH       ; Carriage Return
LF      EQU  0AH       ; Line Feed
EOTEXT  EQU  '$'       ; end of text sign
STORE   EQU  0300H     ; first byte of storage
```

```
BACKSP  EQU  08          ; backspace
SPACE   EQU  20H         ; ASCII space
LSTOUT  EQU  5           ; Page Zero character to printer
UPPERR  EQU  52H         ; upper case R
LOWERR  EQU  72H         ; lower case r
```

Addr.	Obj. Code	Label	8080	Z-80	comment
0200			ORG 200H	ORG 200H	
0200	E5	READIN:	PUSH H	PUSH HL	; wait for
0201	0E01		MVI C,INKEY	LD C,INKEY	; and read
0203	CD0500		CALL PZERO	CALL PZERO	; key
0206	E1		POP H	POP HL	
0207	C9		RET	RET	
0208	E5	CRTLF:	PUSH H	PUSH HL	; adds screen line
0209	0E0A		MVI C,LF	LD C,LF	; feed to CR
020B	CD0CDE		CALL CRTOUT	CALL CRTOUT	; detected
020E	E1		POP H	POP HL	; in main routine
020F	C9		RET	RET	
0210	E5	PRTCLR:	PUSH H	PUSH HL	; CR during
0211	0E0D		MVI C,CR	LD C,CR	; print
0213	CD0FDE		CALL BLST	CALL BLST	
0216	E1		POP H	POP HL	
0217	E5	PRTLF:	PUSH H	PUSH HL	; LF during
0218	0E0A		MVI C,LF	LD C,LF	; print
021A	CD0FDE		CALL BLST	CALL BLST	
021D	E1		POP H	POP HL	
021E	C9		RET	RET	
021F	E5	BLANK:	PUSH H	PUSH HL	; backspace
0221	0E02		MVI C,OUTTXT	LD C,OUTTXT	; and erase
0223	1E20		MVI E,SPACE	LD E,SPACE	; one character
0224	CD0500		CALL PZERO	CALL PZERO	
0227	1E08		MVI E,BACKSP	LD E,BACKSP	
0229	0E02		MVI C,OUTTXT	LD C,OUTTXT	
022B	CD0500		CALL PZERO	CALL PZERO	
022E	E1		POP H	POP HL	
022F	C9		RET	RET	
0230	0E1B	CLSCRN:	MVI C,CBYTE1	LD C,CBYTE1	; clear screen
0232	CD0CDE		CALL CRTOUT	CALL CRTOUT	; and home cur-
					; sor
0235	0E3A		MVI C,CBYTEX	LD C,CBYTEX	
0237	CD0CDE		CALL CRTOUT	CALL CRTOUT	
023A	C9		RET	RET	

```
Addr.  Obj. Code  Label    8080           Z-80           comment

0100               ORG 100H       ORG 100H
0100   CD3002      START:  CALL CLSCRN    CALL CLSCRN
0103   210003             LXI H,STORE    LD HL,STORE
0106   CD0002      NEXT:   CALL READIN    CALL READIN
0109   77                 MOV M,A        LD (HL),A      ; key code in
                                                         ; storage
010A   23                 INX H          INC HL         ; point to next
                                                         ; byte
010B   FE08               CPI BACKSP     CP BACKSP      ;
010D   C21801             JNZ NOBACK     JP NZ,NOBACK   ; if backspace
                                                         ; remove
0110   2B                 DCX H          DEC HL         ;
0111   2B                 DCX H          DEC HL         ; character from
                                                         ; screen
0112   CD1F02             CALL BLANK     CALL BLANK     ; and storage
0115   C30601             JMP NEXT       JP NEXT        ; if CR provide
0118   FE0D        NOBACK: CPI CR         CP CR          ; line feed on
                                                         ; screen
011A   C22301             JNZ NOLF       JP NZ,NOLF     ; but not in
                                                         ; storage
011D   CD0802             CALL CRTLF     CALL CRTLF
0120   C30601             JMP NEXT       JP NEXT
0123   FE24        NOLF:   CPI EOTEXT     CP EOTEXT      ; go to key input
0125   C20601             JNZ NEXT       JP NZ,NEXT     ; if not eotext.
0128   210003      PRINT:  LXI H,STORE    LD HL,STORE    ; reset storage
                                                         ; pointer
012B   7E          NEXTP:  MOV A,M        LD A, (HL)     ; fetch byte
012C   FE24               CPI EOTEXT     CP EOTEXT      ; until eotext
                                                         ; sign
012E   CA4601             JZ DONE        JP Z,DONE
0131   0E05               MVI C,LSTOUT   LD C,LSTOUT    ; call Page Zero
0133   5F                 MOV E,A        LD E,A         ; print routine
0134   E5                 PUSH H         PUSH HL
0135   CD0500             CALL PZERO     CALL PZERO
0138   E1                 POP H          POP HL
0139   7E                 MOV A,M        LD A,(HL)      ; fetch same byte
013A   FE0D               CPI CR         CP CR          ; if CR add LF
013C   C24201             JNZ NONLIN     JP NZ,NONLIN   ;
013F   CD1702             CALL PRTLF     CALL PRTLF
0142   23          NONLIN: INX H          INC HL         ; point to next
                                                         ; byte
0143   C32B01             JMP NEXTP      JP NEXTP
0146   CD1002      DONE:   CALL PRTCLR    CALL PRTCLR    ; blank lines
0149   CD1002             CALL PRTCLR    CALL PRTCLR
014C   CD1002             CALL PRTCLR    CALL PRTCLR
014F   CD1002             CALL PRTCLR    CALL PRTCLR
0152   CD0002             CALL READIN    CALL READIN    ; read keyboard
0155   FE52               CPI UPPERR     CP UPPERR      ; print again if
0157   CA2801             JZ PRINT       JP Z,PRINT     ; required key
                                                         ; has
015A   FE72               CPI LOWERR     CP LOWERR      ; been pressed.
015C   CA2801             JZ PRINT       JP Z,PRINT
```

Disk File Random Access

The examples conclude with a more extensive program of file creation and retrieval. The program listed below performs the simple function of reading or writing random records upon command from the terminal. Given that the program has been created, assembled, and placed into a file labeled RANDOM.COM, the CCP level command

```
RANDOM X.DAT
```

starts the test program. The program looks for a file by the name X.DAT (in this particular case) and, if found, proceeds to prompt the console for input. If not found, the file is created before the prompt is given. Each prompt takes the form

```
next command?
```

and is followed by operator input, terminated by a carriage return. The input commands take the form

```
nW  nR  Q
```

where n is an integer value in the range 0 to 65535, and W, R, and Q are simple command characters corresponding to random write, random read, and quit processing, respectively. If the W command is issued, the RANDOM program issues the prompt

```
type data:.
```

The operator then responds by typing up to 127 characters, followed by a carriage return. RANDOM then writes the character string into the X.DAT file at record n. If the R command is issued, RANDOM reads record number n and displays the string value at the console. If the Q command is issued, the X.DAT file is closed, and the program returns to the CCP. In the interest of brevity, the only error message is

```
error, try again.
```

The program begins with an initialization section where the input file is opened or created, followed by a continuous loop at the label "ready" where the individual commands are interpreted. The default file control block at 005CH and the default buffer at 0080H are used in all disk operations. The utility subroutines then

follow, which contain the principal input line processor, called "readc." This particular program shows the elements of random access processing, and can be used as the basis for further program development.

The equate statements:

```
REBOOT  EQU  0000H      ; system reboot
PZERO   EQU  0005H      ; Page Zero entry point
INKEY   EQU  1          ; console input function
CRTOUT  EQU  2          ; console output function
OUTSTR  EQU  9          ; print string until '$'
RSTRING EQU  10         ; read console buffer
VERSION EQU  12         ; return version number
OPENF   EQU  15         ; file open function
CLOSEF  EQU  16         ; close function
MAKEF   EQU  22         ; make file function
READR   EQU  33         ; read random
WRITER  EQU  34         ; write random

FCB     EQU  005CH      ; default file control block
RANREC  EQU  FCB+33     ; random record position
RANOVF  EQU  FCB+35     ; high order (overflow) byte
BUFF    EQU  0080H      ; buffer address

CR      EQU  0DH        ; carriage return
LF      EQU  0AH        ; line feed
```

Addr.	Obj. Code	Label	8080	Z-80	comment
		Load SP, Set-Up File for Random Access			
			ORG 100H	ORG 100H	
0100	31BC02		LXI SP,STACK	LD SP,STACK	
		;			
		;	version 2.0 or better?		
0103	0E0C		MVI C,VERSION	LD C,VERSION	
0105	CD0500		CALL PZERO	CALL PZERO	
0108	FE20		CPI 20H	CP 20H	
010A	D21601		JNC VERSOK	JP NC,VERSOK	
		;	bad version, message and go back		
010D	111B00		LXI D,BADVER	LD DE,BADVER	
0110	CDDA01		CALL PRINT	CALL PRINT	
0113	C30000		JMP REBOOT	JP REBOOT	
		;			

```
Addr.  Obj. Code  Label   8080          Z-80          comment

                   VERSOK:
                   ;       correct version for random access
0116   0E0F                MVI C,OPENF   LD C,OPENF
0118   115C00              LXI D,FCB     LD DE,FCB
011B   CD0500              CALL PZERO    CALL PZERO
011E   3C                  INR A         INC A         ; err 255
011F   C23701              JNZ READY     JP NZ,READY   ; becomes 0
                   ;       cannot open file, so create it
0122   0E16                MVI C,MAKEF   LD C,MAKEF
0124   115C00              LXI D,FCB     LD DE,FCB
0127   CD0500              CALL PZERO    CALL PZERO
012A   3C                  INR A         INC A         ; err 255
012B   C23701              JNZ READY     JP NZ,READY   ; becomes 0
                   ;
                   ;       cannot create file, directory full
012E   113A02              LXI D,NOSPACE LD DE,NOSPACE
0131   CDDA01              CALL PRINT    CALL PRINT
0134   C30000              JMP REBOOT    JP REBOOT

                   Loop Back to Ready After Each Command

                   ;
                   READY:
                   ;       file is ready for processing
                   ;
0137   CDE501              CALL READCOM  CALL READCOM ;next com-
                                                      ;mand
013A   227D00              SHLD RANREC   LD(RANREC),HL;store input
                                                      ;record #
013D   217F00              LXI H,RANOVF  LD HL,RANOVF
0140   3600                MVI M,0       LD (HL),0
0142   FE51                CPI 'Q'       CP 'Q'        ; quit
0144   C25601              JNZ NOTQ      JP NZ,NOTQ
                   ;
                   ;       quit processing, close file
0147   0E10                MVI C,CLOSEF  LD C,CLOSEF
0149   115C00              LXI D,FCB     LD DE,FCB
014C   CD0500              CALL PZERO    CALL PZERO    ; err 255
014F   3C                  INR A         INC A         ; becomes 0
0150   CAB901              JZ ERROR      JP Z,ERROR
0153   C30000              JMP REBOOT    JP REBOOT

                   End of Quit Command, Process Write

                   NOTQ:
                   ;       not the quit command, random write?
0156   FE57                CPI 'W'       CP 'W'
0158   C28901              JNZ NOTW      JP NZ,NOTW
                   ;
                   ;       this is a random write, fill buffer until cr
015B   114D02              LXI D,DATMSG  LD DE,DATMSG
015E   CDDA01              CALL PRINT    CALL PRINT
0161   0E7F                MVI C,127     LD C,127      ; max character
0163   218000              LXI H,BUFF    LD HL,BUFF    ; destination
```

```
Addr.  Obj. Code   Label     8080            Z.80            comment

                   RLOOP:    ;read next character
0166   C5                    PUSH B          PUSH BC
0167   E5                    PUSH H          PUSH HL
0168   CDC201                CALL GETCHR     CALL GETCHR ; char to reg A
016B   E1                    POP H           POP HL
016C   C1                    POP B           POP BC
016D   FE0D                  CPI CR          CP CR           ; end of line?
016F   CA7801                JZ ERLOOP       JP Z,ERLOOP
                   ;         not end, store character
0172   77                    MOV M,A         LD (HL),A
0173   23                    INX H           INC HL          ; next to fill
0174   0D                    DCR C           DEC C
0175   C26601                JNZ RLOOP       JP NZ,RLOOP ; end of buffer?
                   ERLOOP:
                   ;         end of read loop, store 00
0178   3600                  MVI M,0         LD (HL),0
                   ;
                   ;         write the record to selected record number
017A   0E22                  MVI C,WRITER    LD C,WRITER
017C   115C00                LXI D,FCB       LD DE,FCB
017F   CD0500                CALL PZERO      CALL PZERO
0182   B7                    ORA A           OR A            ; error code 0?
0183   C2B901                JNZ ERROR       JP NZ,ERROR
0186   C33701                JMP READY       JP READY        ; another record
```

End of Write Command, Process Read

```
                   NOTW:
                   ;         not a write command, read record?
0189   FE52                  CPI 'R'         CP 'R'
018B   C2B901                JNZ ERROR       JP Z,ERROR
                   ;
                   ;         read reandom record
018E   0E21                  MVI C,READR     LD C,READR
0190   115C00                LXI D,FCB       LD DE,FCB
0193   CD0500                CALL PZERO      CALL PZERO
0196   B7                    ORA A           OR A            ; return code 0?
0197   C2B901                JNZ ERROR       JP NZ,ERROR
                   ;
                   ;         read was successful, write to console
019A   CDCF01                CALL CRLF       CALL CRLF       ; new line
019D   0E80                  MVI C,128       LD C,128        ; max chars
019F   218000                LXI H,BUFF      LD HL,BUFF      ; point to next
                   WLOOP:
01A2   7E                    MOV A,M         LD A,(HL)       ; next char
01A3   23                    INX H           INC HL          ; point to next
01A4   E67F                  ANI 7FH         AND 7FH         ; mask bit 7
01A6   CA3701                JZ READY        JP NZ,READY ; another com-
                                                             ; mand
01A9   C5                    PUSH B          PUSH BC
01AA   E5                    PUSH H          PUSH HL
01AB   FE20                  CPI ' '         CP ' '          ; allowable char?
01AD   D4C801                CNC PUTCHR      CALL NC,PUTCHR
                                                             ; only if allowa-
                                                             ; ble
```

Addr.	Obj. Code	Label	8080	Z-80	comment
01B0	E1		POP H	POP HL	
01B1	C1		POP B	POP BC	
01B2	0D		DCR C	DEC C	; counter
01B3	C2A201		JNZ WLOOP	JP Z,WLOOP	
01B6	C33701		JMP READY	JP READY	

End of Read Command, All Errors End Up Here

```
                        ;
                        ERROR:
01B9    115902                  LXI D,ERRMSG LD DE,ERRMSG
01BC    CDDA01                  CALL PRINT   CALL PRINT
01BF    C33701                  JMP READY    JP READY
```

Utility Subroutines for Console I/O

```
                        GETCHR:
                                ;read next console character to a
01C2    0E01                    MVI C,INKEY  LD C,INKEY
01C4    CD0500                  CALL PZERO   CALL PZERO
01C7    C9                      RET          RET
                        ;
                        PUTCHR:
                                ;write character from a to console
01C8    0E02                    MIV C,CRTOUT LD C,CRTOUT ; character
01CA    5F                      MOV E,A      LD E,A      ; to screen
01CB    CD0500                  CALL PZERO   CALL PZERO
01CE    C9                      RET          RET
                        ;
                        CRLF:
                                ;send carriage return line feed
01CF    3E0D                    MVI A,CR     LD A,CR
01D1    CDC801                  CALL PUTCHR  CALL PUTCHR
01D4    3E0A                    MVI A,LF     LD A,LF
01D6    CDC801                  CALL PUTCHR  CALL PUTCHR
01D9    C9                      RET          RET
                        ;
                        PRINT:
                                ;print the buffer addressed by de until $
01DA    D5                      PUSH D       PUSH DE
01DB    CDCF01                  CALL CRLF    CALL CRLF
01DE    D1                      POP D        POP DE
01DF    0E09                    MVI C,OUTSTR LD C,OUTSTR
01E1    CD0500                  CALL PZERO   CALL PZERO
01E4    C9                      RET          RET
                        ;
                        READCOM:
                                ;read the next command line to the conbuf
01E5    116B02                  LXI D,PROMPT LD DE,PROMPT
01E8    CDDA01                  CALL PRINT   CALL PRINT  ; 'command?'
01EB    0E0A                    MVI C,RSTRING LD C,RSTRING
01ED    117A02                  LXI D,CONBUF LD DE,CONBUF
01F0    CD0500                  CALL PZERO   CALL PZERO
```

```
Addr.  Obj. Code   Label    8080              Z-80              comment

                   ;        command line is present, scan it
01F3   210000               LXI H,0           LD HL,0
01F6   117C02               LXI D,CONLIN      LD DE,CONLIN ; command line
01F9   1A           READC:  LDAX D            LD A,(DE)    ; command char
01FA   13                   INX D             INC DE       ; point to next
                                                           ; char
01FB   B7                   ORA A             OR A         ; zero char?
01FC   C8                   RZ                RET Z
                   ;        not zero, numeric?
01FD   D630                 SUI '0'           SUB '0'
01FF   FE0A                 CPI 10            CP 10
0201   D21302               JNC ENDRD         JP NC,ENDRD  ; i.e. if not
                   ;        add-in next digit                ; numeric
0204   29                   DAD H             ADD HL,HL    ; *2
0205   4D                   MOV C,L           LD C,L
0206   44                   MOV B,H           LD B,H       ; bc = value *2
0207   29                   DAD H             ADD HL,HL    ; *4
0208   29                   DAD H             ADD HL,HL    ; *8
0209   09                   DAD B             ADD HL,BC    ; *10
020A   85                   ADD L             ADD A,L      ; + digit
020B   6F                   MOV L,A           LD L,A
020C   D2F901               JNC READC         JP NC,READC  ; another char
020F   24                   INR H             INC H
0210   C3F901               JMP READC         JP READC
                   ENDRD:
                   ;        end of read, restore value in a
0213   C630                 ADI '0'           ADD A,'0'
0215   FE61                 CPI 'A'           CP 'a'       ; translate
0217   D8                   RC                RET C        ; case?
                   ;        lower case, mask lower case bits
0218   E65F                 ANI 01011111B     AND 01011111B
021A   C9           RET     RET
```

Areas for data storage required by the program:

String Data Area for Console Messages

```
                   BADVER:
021B   536F72               DB        'Sorry, you need cp/m version 2$'
                   NOSPACE:
023A   4E6F20               DB        'No directory space$'
                   DATMSG:
024D   547970               DB        'Type data: $'
                   ERRMSG:
0259   457272               DB        'Error, try again $'
                   PROMPT:
026B   4E6578               DB        'Next command? $'
                   ;
```

Fixed and Variable Data Area

```
027A    21          CONBUF: DB      CONLEN      ; length of console buffer
027B                CONSIZ: DS      1           ; resulting size after read
027C                CONLIN: DS      32          ; length 32 buffer
0021 =              CONLEN  EQU     $-CONSIZ
                    ;
029C                        DS      32          ; 16 level stack
                    STACK:
02BC                        END
```

INTERFACING PRINTERS

The following presents a brief summary of the signals essential to the operation of the user's serial or parallel printing device. The exact pin configuration and cable requirements are given in the "Hardware Description."

This is the sequence of signals between NCR DECISION MATE V and a serial printer:

NCR DECISION MATE V	PRINTER
1.	Printer sets XON signal to enable computer to transmit data.
2. Transmission is enabled, so data are transmitted bit by bit via the TxD line.	
3.	When the printer buffer is nearly (typically 3/4) full, an XOFF signal is generated.
4. The computer waits with further data . . .	. . .while the printer empties its its buffer.
5.	When the buffer is empty, XON is once again generated.
6. Data transmission is once again enabled.	

The XOFF status is equivalent to 13H being read IN at port 60. Otherwise XON is assumed. The DTR and DSR lines are connected together inside the serial printer interface kit. In addition CTS and

RTS should be connected together. Both these combinations and the CD line should be at +12V (i.e. ON).

For the parallel (Centronics) interface the procedure is similar. Printer Busy or Printer Buffer Full return 20H and 02H respectively. Therefore, if neither bit 1 nor bit 5 is set upon a read IN at port 61, the printer is ready to receive data.

For full details of interface connections and the significance of the individual control lines, you can refer to the Hardware Section. Users of non-NCR serial printers which do not use XON/XOFF protocol can, with the aid of the printer manufacturer's description, find suitable lines for connection to K211 or K212 kit.

For details of the serial and parallel interface integrated circuits and their programming procedures, advanced programmers should refer to the manufacturers' software descriptions of the integrated circuits used (not included in this description). The serial interface IC is the 2651, the parallel interface IC is the 8255.

A 2651 is used not only for the serial printer interface, but also for the serial communications interface kit (K211, see Hardware Description). Figure 3.11 summarizes the actual port addresses used by these interfaces.

2651 REGISTER ADDRESSING

Port (Hex) K212 K213	Port (Hex) K211	Signals Required * CE	BA0	BA1	BA2	Function
—	—	1	X	X	X	Tri-state data bus
60	70	0	0	0	0	Read receive holding register
64	74	0	0	0	1	Write transmit holding register
61	71	0	1	0	0	Read status register
65	75	0	1	0	1	Write SYN1/SYN2/DLE registers
62	72	0	0	1	0	Read mode registers 1/2
66	76	0	0	1	1	Write mode registers 1/2
63	73	0	1	1	0	Read command register
67	77	0	1	1	1	Write command register

* These pin designations (see Hardware Description) correspond to the following bus lines: BA0 - A0, BA1 - A1, BA2 - $\overline{R}$/W.

Figure 3.11

CAUTION

The user must take extreme care when connecting an external device to a peripheral adapter. You should not only read the relevant parts of the "Hardware Description" in this manual, but also the equivalent information concerning the external device to be connected. Failure to take device characteristics into consideration will mean that the software will not function. It may also result in permanent damage to your computer, adapter, or external device.

TABLES-ROUTINES-PORTS

Tables

The following areas of data storage are contained in the BIOS area. The numbers in parentheses following the BIOS section designations refer to line numbers in the BIOS program listing contained in the Appendix.

N(210)
The BIOS entry points: a vector of unconditional jump instructions.

N(450)
The final machine addresses for the BIOS functions.

N(710)
Addresses of NBIOS tables; I/O Byte data; number of flexible disk drives; retry/restore counters; system recovery parameters; standard parameters for serial I/O.

N(760)
Table of Function Key functions.

N(880)
Language translate table for specific keyboards.

N(960)
Keyboard translate table for hex values >7F.

N(1005)
Error messages.

N(1030)
Memory areas used for disk information.

N(1570)
Disk format data for NCR SS-DD, NCR DS-DD, non NCR, and Hard Disk.

O(1360)
FDC Command and Error storage.
O(1370)
Parameter block for sector one read.
O(1390)
Disk information storage.
P(1070)
Data table of CRT control functions.
P(2080)
Storage area for video data.
Q(630)
Storage area for Function Key data.
Q(940)
Serial/parallel interface active and XOFF flags.

Routines

This section presents tables of cross references regarding CALL instructions (including conditional calls) to routines external to the calling section. Calls to the basic arithmetic routines contained in NBIOS (MULT, MOVE, MOVEL, SUBHLDE, COMDEHL, CMPRE, OFST) are not included.

called by NBIOS			
ROUTINE	LOCATION IN BIOS	ROUTINE	LOCATION IN BIOS
CHECKOS	O	READID	O
CONIN	P	READSEC1	O
CONOUT	P	RDTRAK	O
CREAD	O	RESET	O
DISKIO	O	SECSET	O
DMASET	O	TRKSET	O
DSKERR	O	WINIT	P
DSKSET	O	WRCUPO	P

Figure 3.12 (1 of 4)

called by OBIOS	
ROUTINE	LOCATION IN BIOS
CLOSE	N
CLRLIN	N
CONIN	P
DISPERR	N
DSKGET	N
FIXINIT	N
FLUSH	N

Figure 3.12 (2 of 4)

called by PBIOS	
ROUTINE	LOCATION IN BIOS
CRLIN	N
GETLPOS	Q
KBDINIT	Q

Figure 3.12 (3 of 4)

called by QBIOS	
ROUTINE	LOCATION IN BIOS
ROUTE	P
TRNCHR	P

Figure 3.12 (4 of 4)

Ports

The following is a summary of the available I/O ports used by the BIOS. The following information regarding each port is given:

- Hexadecimal port number as used in assembler IN and OUT instructions, and whether used as Input or Output Port by the BIOS.
- The BIOS symbolic name for the port and the BIOS routines using it.
- Additional information regarding BIOS use of the port.

CAUTION

The ports in your NCR DECISION MATE V are used not only by your operating system, but also by the firmware which becomes active at power up. Under no circumstances should you attempt to make use of IN or OUT (including block transfer) instructions at ports which are connected to Timer functions, otherwise permanent damage to your computer may result. A detailed map of the NCR DECISION MATE V ports is given at the end of this section (Figure 3.13). Suggestions regarding the use of GDC ports are given in the section "Graphics."

IN 13
SYSSTA

Used by ID (OBIOS), DMA01 (OBIOS), FDCIN1 (OBIOS), MOTORCK (OBIOS), DSKERR (OBIOS).
ID and FDCIN1 use this port to check and wait for an interrupt from the disk controller. The interrupt is only valid if bit 3 in register A is set following the IN instruction. The routine will then proceed to read the disk identity.
DMA01 and DSKERR check bit 2. If bit 2 is not set, then the disk is not ready.
MOTORCK checks bit 0. If bit 0 is set, then the motor is not yet switched on.

OUT 14
MOTORON

Used by MOTORCK (OBIOS).
MOTORCK uses bit 0 to turn the motor on.

zum DMS-Monitor mit eingebautem ROM: JP AAC

OUT 26
COAD

Used by DMA1 (OBIOS).
The DMA address is transmitted via this port, first the low byte followed by the high byte without any intervening control information.

OUT 27
COTC

Used by DMA1 (OBIOS).
The DMA length is transmitted via this port, first the low byte followed by the high byte without any intervening control information.

OUT 2A
DMAMB

Used by DMA1 (OBIOS) and DMA01 (OBIOS).
Bits 0 and 1 are set, other bits reset, to enable the FDC channel following initialization of DMA.
To disable the FDC channel, bits 0, 1, and 2 are set.

OUT 2B
DMAMO

Used by DMA1 (OBIOS) to set the DMA mode.
To set the read mode, bits 0, 1, 2, 3, and 6 are set, the others reset. For the write mode, bit 0, 1, 2, and 6 are set, the others reset.

IN 40
RDKEY

Used by BELL (PBIOS), KBDINIT (QBIOS), and PKEYIN (QBIOS).
Reads a character from the keyboard.

IN 41
RSKEY

Used by BELL (PBIOS), KBDINIT (QBIOS), and PKEYST (QBIOS).
A character is ready if bit 0 is set. The language code is ready if bit 7 is set.

OUT 41
KBELL

Used by BELL (PBIOS). Also KCOUNT used by KBDINIT (QBIOS).
Drives the loudspeaker. If value Reg. A = 1, then it constitutes an instruction to return the country code during keyboard initialization.

IN 50
DSTAT
Used by FDCRD1 (OBIOS) and DMA01 (OBIOS).
Bit 7 set indicates that disk is ready.
OUT 51
DCOMD
Used by DHOME (OBIOS), FDCWAIT (OBIOS), FDCINI1 (OBIOS).
Used in the transmission of disk, head, and track number to the disk controller.
IN 51
FDCRA
Used by FDCINI1 (OBIOS) and GETBY (OBIOS) to read in information from the disk controller.
IN 60
SPRDATA
Used by SRLINST (QBIOS) and SRLIN (QBIOS).
Reads in data from serial interface, including XON/XOFF status.
OUT 60
PBDA
Used by PRTOUT (QBIOS) as output port for parallel data transmission.
IN 61
SPRSTAT
Used by SRLINST (QBIOS) and SRLPRST (QBIOS); also PBSTA used by PRTSTAT (QBIOS).
This status port for the serial interface is used to detect overrun, parity, or framing errors. Bit 3 set indicates a framing error, bit 5 set indicates a parity error, and bit 4 set indicates an overrun. Bit 1 set is used to indicate that the transmitter is ready.
For the parallel interface, bit 1 set or bit 5 set indicates that the device is not yet ready.
IN 63, OUT 67
SPRCOM, SPWCOM
Reads and transmits error information.
OUT 63
PBCOM
Used by PIOINIT to initialize the parallel interface.
OUT 64
SPWDATA
Used by SRLCOUT for serial output of data.

OUT 66
SPWMODE

Used by SIOINIT to initialize the serial interface. The first of the two output commands determines stop bits, parity, and character length, using the data stored in NBIOS (line 710, see "Tables"). The second command determines the baud rate.

OUT 67
SPWCOM

Used to enable transmitter and receiver in the serial interface.

IN A0
GDCSTA

Used in console I/O to determine whether the graphic display unit can accept a character. Bit 1 reset means a character can be transmitted. Bit 0 set means that data is ready for transmission to the graphic display. Bit 3 set means that drawing is actually being carried out.

OUT A0, OUT A1
GDPAR, GDCOM

Used for output of control and printable data to the graphic display in QBIOS.

IN C0
DATA

Used in RBIOS for block input of data from the Winchester disk controller (256 bytes at a time).

OUT C0
DATA

Used in RBIOS for block output of data to the Winchester disk controller (256 bytes at a time).

IN C1
ERROR

Used in RBIOS for detailed definition of error detected upon reading from a Winchester Disk. Bit 5 set denotes an error in the ID field revealed by the Cyclic Redundancy Check. Bit 6 set indicates an error in the data field. If neither of these two bits is set, the error cannot be defined and is considered to be a fatal error.

OUT C2
SECNT

Used in RBIOS to set the sector number during formatting.

IN C3
SECNO

Used in RBIOS to check whether disk controller is ready.

OUT C3
SECNO
Used in RBIOS to set a sector number. Output 55H indicates that disk controller is ready.
IN C4
CYLLO
Used in RBIOS to check whether disk controller is ready.
OUT C4
CYLLO
Used in RBIOS to set a cylinder number. Output 0AAH is used for checking purposes.
OUT C5
CYLHI
Used in RBIOS to set the higher order part of the cylinder number.
OUT C6
SDH
Used in RBIOS to give the Winchester disk controller information regarding drive, head, sector size, and error checking. All this control information is passed in a single output instruction (see RBIOS, page 10).
IN C7
Used in RBIOS to accept status information from the Winchester disk controller. Bit 7 set indicates that the controller is busy. Bit 6 set indicates that the drive is not ready. Bit 4 set indicates that the drive search is not completed.
OUT C7
Used in RBIOS to select the read (20H) or write (30H) function.

OUT 10
Bit 0 set switches the first 2000H bytes of main memory into the address area 0-1FFFH.
OUT 11
Bit 0 set switches the firmware ROM into the address area 0-1FFFH.
OUT D0
Bit 0 set switches to the Z-80® processor. If the Z-80 processor is presently activated, the 16-bit processor becomes active in its place.

Figure 3.13 provides a detailed map of the NCR DECISION MATE V ports. Before referring to this figure, you must read the cautionary note which immediately precedes the list of ports used by the BIOS.

LOW / HIGH	0	1	2	3	4	5	6	7
0	ERROR LEDS							
1	RAMSEL	ROMSEL	SETTC	SYSSTAT	MOTOR			
2								
3	IFSEL 2A K806							
4	KEY: R/W DATA	KEY: R/W COMMAND						
5	FDC: R-MAIN STATUS	FDC: R/W DATA						
6	IFSEL 0A K210, K211, K213							
7	IFSEL 1A K211, K215							
8	TIMER: R/W COUNTER 0	TIMER: R/W COUNTER 1	TIMER: R/W COUNTER 2	TIMER: W-MODE				
9								
A	GDC R-STATUS W-PARAM	GDC R-DATA W-COMMAND	ZOOM					
B	IFSEL 3A							
C	IFSEL 4A WINCHESTER DISK							
D	16-BIT SWITCH							
E	64K RAM	64K RAM	64K RAM	64K RAM	64K RAM	64K RAM	64K RAM	64K RAM
	RAM BANKS 0 - 7							
F	I/O EXPANSION							

Figure 3.13 (1 of 2)

NOTE: In Figure 3.13, the numbers prefixed with K refer to kits available for the NCR DECISION MATE V. A switchable RS-232C interface (K801) which can use any of the IFSEL codes, is also available. When using this kit, you should bear in mind that both hardware and software strapping are required.

This applies also to K215, K803, K804, and K806, as these kits are switchable in the same way. You should therefore ensure that your software can use all the IFSEL codes. The IFSEL codes given in Figure 3.13 for these kits constitute default suggestions.

LOW / HIGH	8	9	A	B	C	D	E	F
0	TIMER COUNTER 0	TIMER COUNTER 1	TIMER COUNTER 2	TIMER WRITE MODE	8255 PORT A: LED	8255 PORT B: SWITCH	8255 PORT C: CONTROL	8255 COMMAND
				D I A G N O S E R				
1								
2	DMA: R-STATUS W-COMMAND	DMA: W-REQ. REG.	DMA: W-FDC ENABLE	DMA: W-MODE	DMA: CLR POINTER	DMA: R-MASTER CLEAR	DMA: CLR MASK REG.	DMA: W-ALL MASK BITS
3	IFSEL 28 K804							
4								
5								
6	IFSEL 08							
7	IFSEL 18							
8								
9								
A								
B	IFSEL 38 K600							
C	IFSEL 48 K803							
D								
E								
F								

Figure 3.13 (2 of 2)

When using K801 with a plotter, you should select IFSEL 0A.

IFSEL 0B is required by hardware in conjunction with K210, K212, and K213.

LEVEL ZERO DIAGNOSTICS

Output to port 00 controls the LED panel situated next to peripheral adapter slot 7. Output zero turns all LEDs on, output FF turns all LEDs off. Figure 3.14 shows the errors indicated by various LED-on combinations. The LED numbers refer to the numbers printed on the LED panel.

LED ON	OUT PORT 00	SIGNIFICANCE
None	FF	Check complete
1+8	7E	Sumcheck error
2+8	BE	GDC error
3+8	DE	Disk drive error
4+8	EE	16-bit processor error
5+8	F6	Keyboard error
6+8	FA	DMA error
7+8	FC	Memory error
All	00	Processor error

Figure 3.14

COLOR

It is not possible to set color by means of a terminal function code. However, you can set color by means of the CRT attribute byte at the absolute memory address F345.

Foreground and background colors are determined by the six most significant bits of the attribute byte (see Figure 3.15). Bit one set activates video blinking.

If you are using one of the special versions of the operating system for either Arabic or the Dead-Key facility, you should also refer to the information immediately following the BIOS link-list at the end of Appendix B.

CRT ATTRIBUTES		
COLOR	Binary value in 3 bits:	
	BACKGROUND (Bits 7, 6, 5)	FOREGROUND (Bits 4, 3, 2)
White	0	7
Cyan	1	6
Magenta	2	5
Blue	3	4
Yellow	4	3
Green	5	2
Red	6	1
Black	7	0

Figure 3.15

GRAPHICS

The operating system software provides you with full access to the character set of your NCR DECISION MATE V. The parameters used in the generation of the CRT display are contained in a 32KB RAM (96KB for color CRTs) accessed via the ports A0 and A1.

A graphics utility program such as NCR-GRAPH provides you with comfortable access to the full graphic capacity beyond that of the character generator contained in the firmware.

If you otherwise wish to access the Graphics Display Controller (GDC), you will find this section especially useful.

The PD7220-1 GDC integrated circuit has an addressing capacity of 256K words of 16 bits each. Facilities provided by the GDC include light pen input, figure drawing of lines, arcs, rectangles, and graphic characters, area filling, and zoom magnification. Communication between GDC and CPU is via the GDC's first-in-first-out buffer. Commands to determine a particular mode of operation are received by the GDC at port A1 (i.e. via the processor OUT 0A1H instruction). Data and other parameters following a particular command are received at port A0. Status information can be read at port A0 (IN 0A0H instruction), and data from the GDC can be read via port A1.

This section deals with the aspects of programming the GDC which relate to its environment in your NCR DECISION MATE V.

Following this, you will find a sample programming session consisting of graphic producing routines which you may wish to adapt and expand for your own applications.

THE GRAPHICS DISPLAY CONTROLLER

The GDC integrated circuit in your NCR DECISION MATE V addresses a CRT display consisting of 640 pixels in the horizontal, and 400 pixels in the vertical direction. The top left-hand corner of the CRT is regarded as the origin of the GDC map. The top (horizontal) line of the screen is represented by the first 640 pixels, the next pixel addresses the far left of the second line, and so on. The GDC makes use of a two-level addressing mode: a word address refers to 16 consecutive pixels, while a 4-bit dot position (values 0-15) refers to an individual pixel within that word. A FIFO buffer is used to pass commands and data to and from the CPU. (Use of the DMA option bypasses this buffer). The contents of this buffer are destroyed only upon a reset or reversal of the direction from read to write or vice versa.

The GDC includes a second buffer, the parameter RAM, in which parameters for figure and character drawing can be loaded and retained. GDC commands which do not explicitly load the parameter RAM do not affect its contents. Therefore, it is possible to make repeated use of the parameter RAM contents without having to reload it. It is even possible to load a specified part of the parameter RAM without altering the rest of its contents.

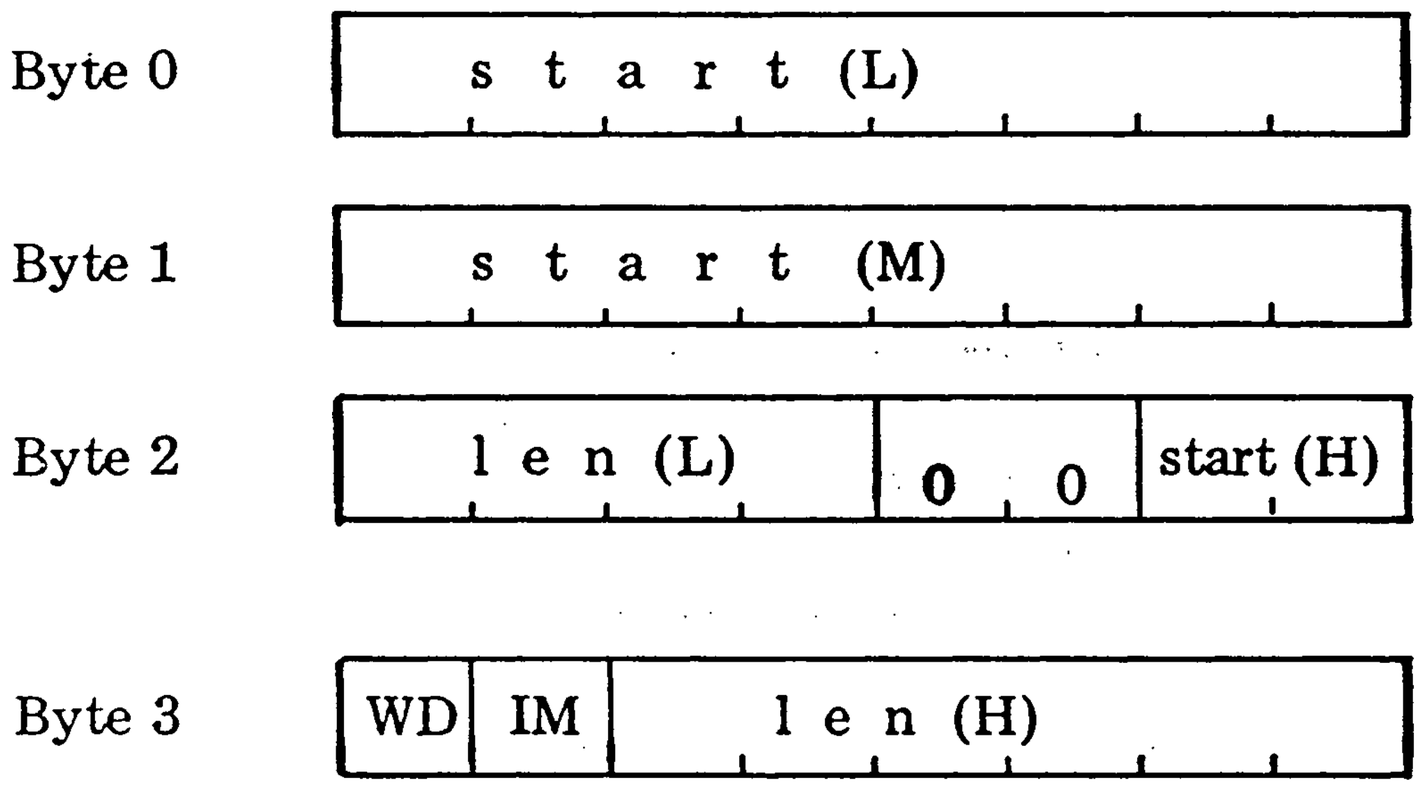
The GDC has two basic modes of operation, namely the Character Mode and the Mixed (Graphics and Character) Mode. The power-up initialization procedure automatically sets the Mixed Mode, as this results in the most efficient non-graphic screen writing in the NCR DECISION MATE V hardware environment. To enable figure drawing it is sufficient to set a flag in the appropriate GDC command. Some additional parameters significant for CRT operation are also sent to the GDC during the power-up initialization. They include horizontal and vertical sync width, horizontal and vertical front and back porch width, type of video framing (non interlaced), type of RAM (dynamic), and the drawing time mode (drawing only during retrace). In the normal course of graphics programming you do not need to set or alter these parameters. However, if you wish to investigate in detail this hardware-related initialization procedure, you can refer to the Hardware Description which comprises the first volume of the System Technical Manual. This first volume includes a listing of the initialization program of the NCR DECISION MATE V firmware in

Z-80 assembly language. You may also wish to refer to the manufacturer's description of the PD7220-1 integrated circuit.

The Parameter RAM

This 16-byte memory area, which is included within the integrated circuit, is used in the Mixed Mode to define two display partition areas and to hold an 8 x 8 pixel graphics character ready for transmission to the display memory. If a figure, and not a graphics character, is to be drawn, the parameter RAM can be used to store a drawing pattern of dots and dashes. The exact layout of the parameter RAM is as follows. Remember that to use the addressing capability of the GDC to the full, an address may consist of up to 18 bits.

Bytes 0-3: these four bytes define the display partition area 1. The start address of this area in display memory is contained in 18 bits. Bytes 0 and 1 contain the least and medium significant byte respectively, while the two most significant bits of the address are contained at bits 0 and 1 of byte 2. The length of this display partition is held in 10 bits (bits 4-7 of byte 2 and, more significant, bits 0-5 of byte 3).



The bit at IM must be set to indicate a bit-mapped graphics area (reset would denote a character area). The bit at WD, which indicates whether 32-bit (wide = set) or 16-bit accessing is activated, should be 0 (reset).

Bytes 4-7: identical structure, this time for definition of display partition area 2.

Bytes 8-15: this area can be used for storing a bit-mapped graphic character in an 8 x 8 pixel format. Upon execution of the appropriate drawing instruction, this area of the parameter RAM is scanned from the least significant bit of byte 15 towards its most significant bit. Scanning then continues from the most significant

bit of byte 14 towards its least significant bit, and so on. If the area to be filled by the parameter RAM is greater than the 8-pixel square, a further subset of the RAM is transmitted to the CRT. If the screen area to be filled is smaller than the 8-pixel square, only a subset of the parameter RAM will appear. Later in this section, you can read how to determine the area on the CRT to be filled, and how to create a slanting (italics) effect.

If you instruct the GDC to do figure drawing instead of drawing a graphic character from the parameter RAM, you can use bytes 8 and 9 for pattern purposes, e.g. to draw dotted or dashed lines.

Remember that the parameter RAM contents are preserved beyond completion of a figure or graphic character drawing instruction, so you can make repeated use of the parameter RAM without having to reload it.

GDC Status Information

Information regarding the busy or otherwise status of the GDC can be read in at port A0. The eight bits thus read by the processor have the following significance.

Bit 0: when set (1), indicates that a byte of data from the GDC RAM is available for reading. The bit is automatically reset as soon as the data transfer from the GDC begins.

Bit 1: when set, this bit indicates that the FIFO buffer is full. Therefore, programs should check that this flag is not set before transmitting a command or parameters to the GDC.

Bit 2: when set, this bit indicates that the FIFO buffer is empty. It is not necessary, nor desireable, to make output to the GDC dependent upon this bit being set, as this would mean dispensing with the advantages offered by buffering. Bit 2 is, however, useful, in that you know that your last command or parameter to the GDC has been accepted from the buffer, if this bit is set.

Bit 3: set while a graphic figure is being drawn.

Bit 4: set while a DMA transfer with the GDC is in progress.

Bit 5: set while vertical retracing on the CRT is in progress.

Bit 6: set while horizontal retracing is in progress. The GDC is set during initialization not to draw during active display time, in order to eliminate display disturbances.

Bit 7: set indicates that the light pen address register contains a deglitched value for the processor.

Commands and their Parameters

The graphics display controller accepts via its FIFO buffer certain commands and parameters which affect the display on the CRT.

The following presents a summary of these commands, with special emphasis on those which are of importance to the setting up of user graphics. The first byte issued to the GDC in each case is the command byte. The bytes (if any) which follow the command byte are the obligatory, or sometimes optional, parameters belonging to that command. The command byte in your NCR DECISION MATE V must always be transmitted via port A1, the parameters via A0. The GDC regards the parameters for the old command as concluded, as soon as a new command is issued. This is true even if the parameter list for the old command is incomplete.

Reset — This command blanks the display, resets the FIFO buffer and the command processor, and sets idle mode.

Command byte: 0.

This command can be issued at any time for the above mentioned purpose. It does not destroy the contents of graphic display memory. RESET can be followed by eight parameters to set mode of display, type of video framing, type of graphic display RAM, number of active display words per line, horizontal and vertical sync, front porch and back porch widths, and the number of active display lines per video field. The tasks are all carried out at power-up initialization so these parameters do not have to be accessed for the purpose of user graphics. The precise initialization procedure is contained in the firmware listings included in the Hardware Description of the System Technical Manual (Volume 1).

Sync: — Command byte: 0FH (display enabled) or 0EH (display blanked).

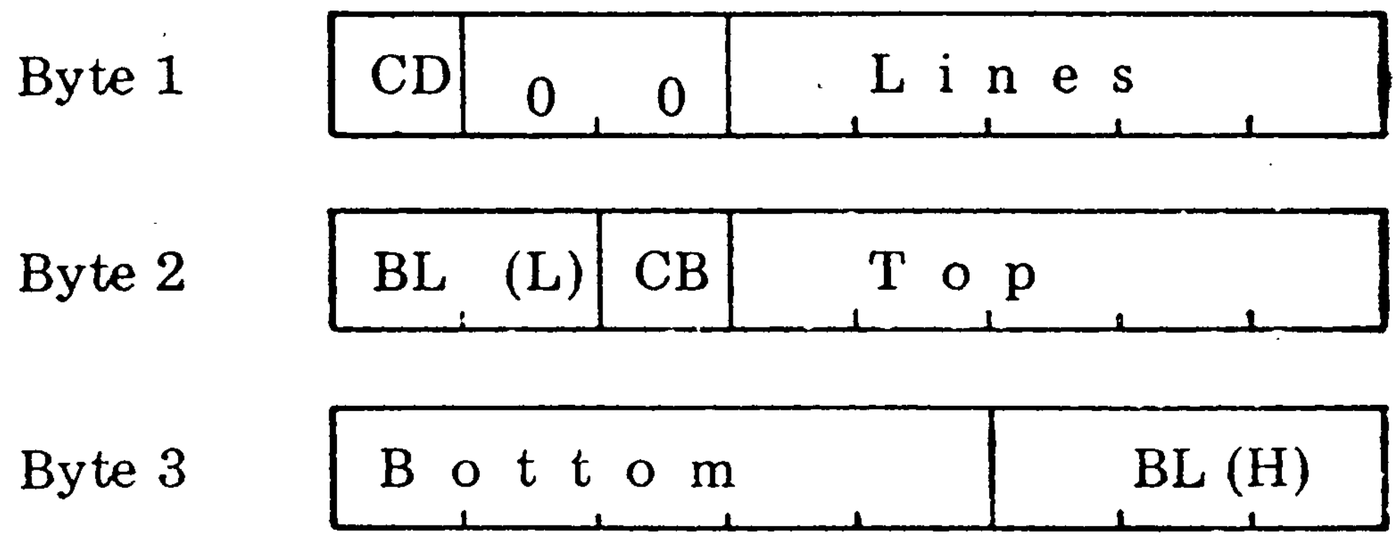
The output parameters are the same as those for the reset command. However, Sync does not reset the GDC or activate idle mode.

Vertical Sync — Command byte: 6EH (slave) or 6FH (master).

This command is meaningful only when more than one GDC is being used to create one image.

Cursor and Character — Command byte: 4BH.

This is normally used to set up the cursor by means of 3 parameter bytes.



Lines refers to the number of display lines to be used for each character row, minus 1. If the CD bit is reset, the cursor is not displayed. Top contains the top line number in the row defined by Lines. If CB is reset, the cursor will blink in accordance with the speed set in BL low and high. For graphics this command is significant inasmuch as the cursor must be set to non-display mode and the number of display lines must be set to zero. In this case, there is no need to transmit bytes 2 and 3.

Start Display — Command byte: 6BH, no parameters.

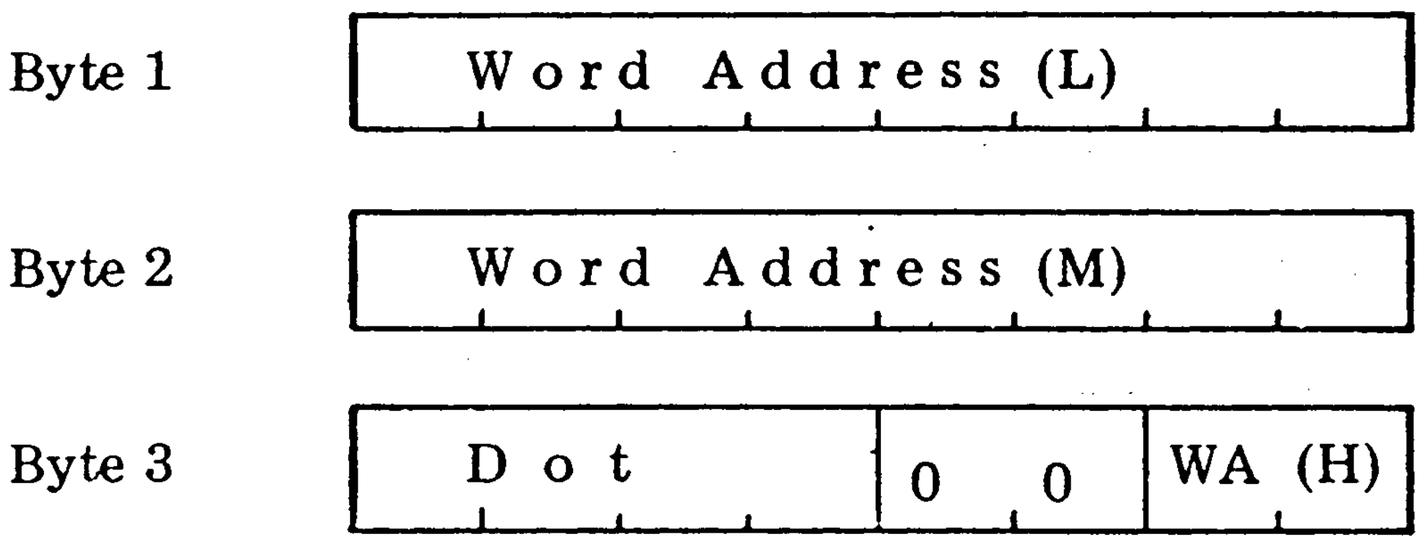
The GDC leaves the idle mode and enters the display mode.

Display On/Off — Command byte: 0CH (display blanked) or 0DH (display active), no parameters.

Zoom — Command byte: 46H.

The single parameter byte which follows this command indicates in its four most significant bits a zoom factor for the entire display, or in its least significant bits, a zoom factor for the graphics character which is about to be transmitted to the GDC. In each case the value 0 indicates no magnification. Magnification, if set, takes place in both x and y directions. A zoom factor specified for a graphic character determines the actual bit-mapping in graphic display memory, so that the enlarged image remains irrespective of subsequent use of the zoom facility. A display zoom factor, on the other hand, does not alter the bit map of the graphic display memory.

Position Cursor — Command byte: 49H.



Word Address (upper 2 bits in byte 3) indicates a 16-pixel boundary, and Dot a pixel position offset to that boundary, where the cursor is to be situated. The character mode does not require parameter byte 3. Remember that the origin for counting word addresses is the top left corner of the CRT. As the GDC in your NCR DECISION MATE V addresses 640 x 400 pixels, a total of 18 bits address capacity is required. This means that WA (H) will be zero. The cursor position in a graphics application is an imaginary one, as it would not usually be desirable to display a cursor.

Load Parameter RAM — This command loads the parameter RAM from a position in that RAM (1 to 15) with the ensuing parameter bytes.

Command byte: bit 7 zero; bits 4, 5, and 6 are set. The four least significant bits contain a value between 0 and 15, according to where in the parameter RAM loading should start.

Example: The command byte 78H tells the GDC that the parameters at port A0 should be loaded into the parameter RAM starting at byte 8, and working towards byte 15.

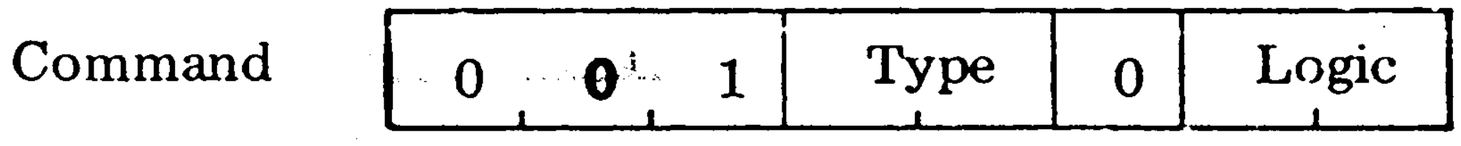
Pitch — Command byte: 47H.

The single byte parameter contains the number of word addresses in a horizontal line of display. The GDC drawing instructions require this information for calculating the word above or below the current word. This value is set at power-up initialization in your NCR DECISION MATE V. The pitch value is also set by the Reset and Sync commands.

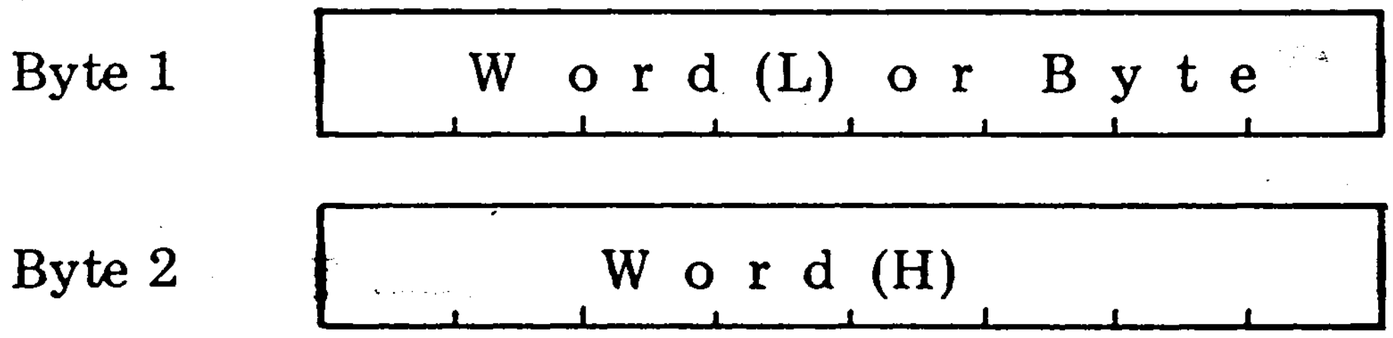
Write Data — This command is an instruction to the GDC to write one word or byte of data into display memory. Following

this, the cursor position is advanced in the last specified direction (see Figure) to the next word address. It is possible to specify a word or byte write. In the latter case, only one, not two, parameters are accepted. In the case of bit-map graphics, only parameter byte 1 is significant, and only then when all bits are set or all bits are reset. In a coded character situation, the bits of the parameter byte(s) set the drawing pattern.

The command byte differs according to the type of transfer and the logical operation which is to govern the write operation.



A zero value in two bits for Type indicates write Word (Low), then Word (High); the value 2 determines that Word (Low), the value 3 that Word (High) should be transmitted; value 1 is invalid. A zero value in two bits for Logic determines that the word or byte addressed by the cursor is to be replaced by the pattern contained in the one or two byte parameters; value 1 means that the individual pixel is to be complemented if the corresponding bit in the pattern is set; analogously, value 2 means reset to zero; and value 3 means set to 1. As already stated, the parameters consist of one or two bytes:



It is admissable to supply further parameter bytes without repeating the command. These will be applied to the automatically advanced cursor position.

The Write Data command must be preceded by a Figure command (only the first three bytes are required, see Figure).

Mask — Command byte: 4AH, followed by two parameter bytes, namely Mask (Low), then Mask (High).

This command sets a 16-bit mask for subsequent figure drawing (the same mask is set by parameter byte 3 of the Position Cursor command). Mask is usually used for clearing or filling large areas of memory, with all the mask bits set. For pixel by pixel drawing there is no need to use the Mask command, as the Cursor Position command can specify the pixel position.

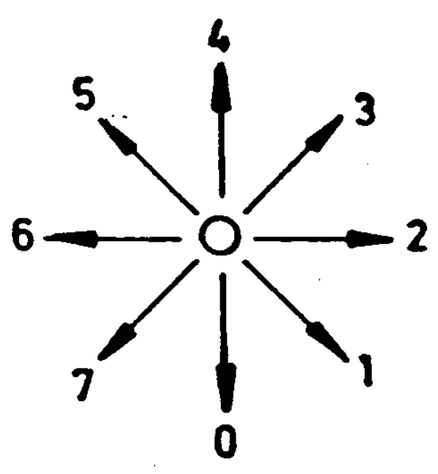
Figure — This command, using as many as 11 parameter bytes, is used for specifying whether individual dot or figure drawing is to take place, and in the latter case, it specifies the figure to be drawn. Beyond this, it is also used for determining the direction of activity for any screen writing. DMA activity also requires certain Figure parameters.

Command byte: 4CH.

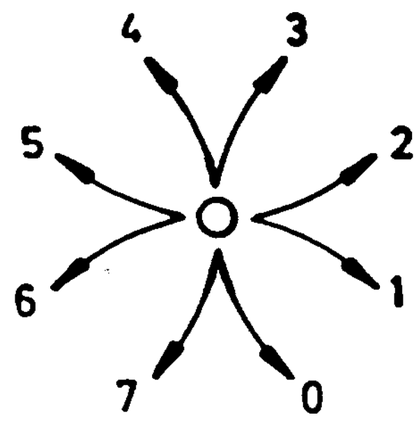
Byte 1	SL	R	A,C	G	L	Direction

The significance of the individual bits of byte 1 is as follows.
SL = slanted graphics character, R = rectangle drawing, A,C = arc or circle drawing, G = graphics character, L = line drawing. None of these bits set denotes individual pixel drawing, character screen writing or reading, or a DMA transfer.

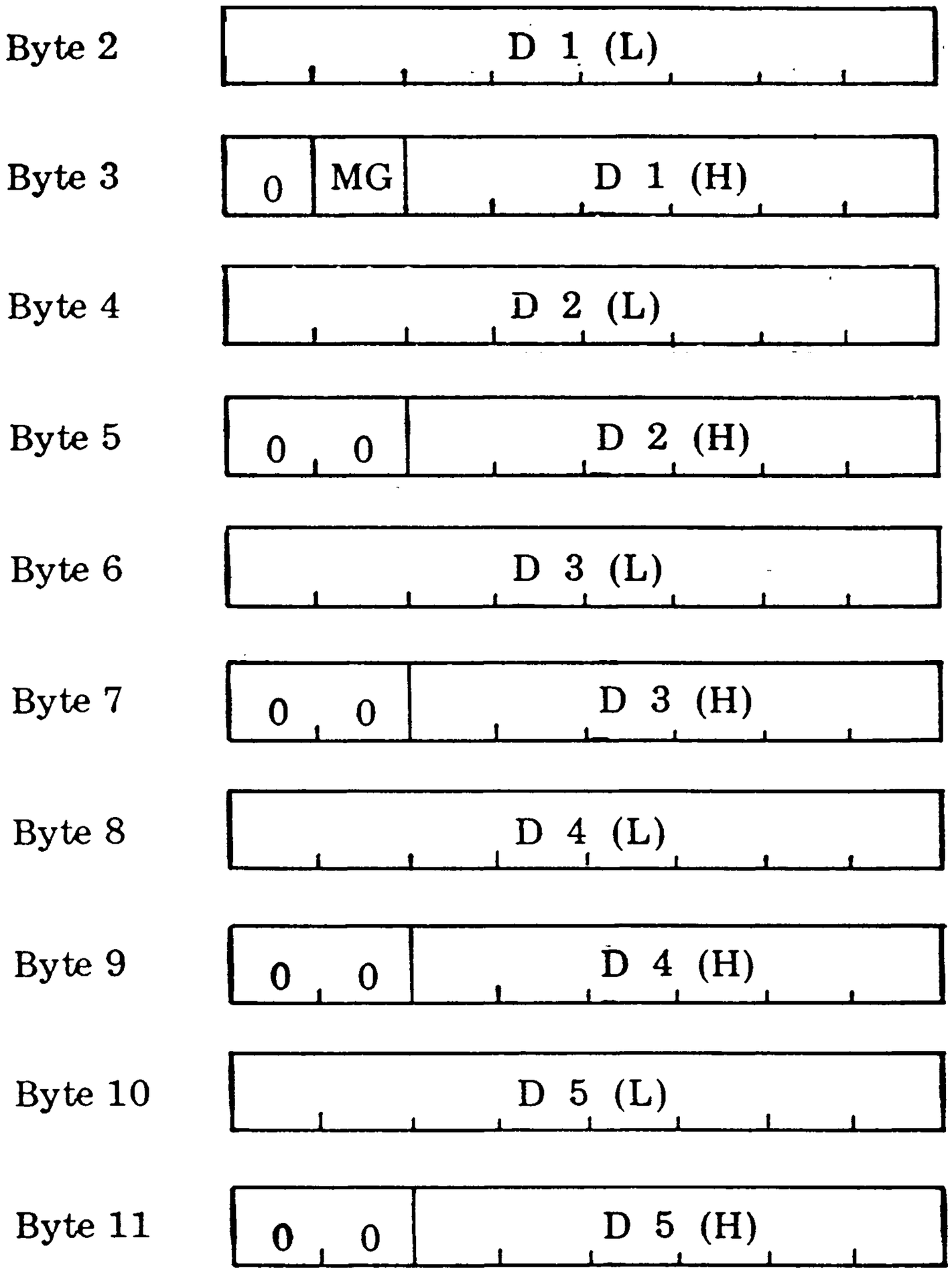
Direction refers to a 3-bit value for the direction of drawing, emanating from the last pixel drawn.



In terms of arc drawing from a point, the following diagram applies:



The remaining parameters are distributed over the remaining ten bytes as follows:



Bit MG in byte 2 must be set to denote graphics drawing.

The values required for the parameters D1 to D5:

Initial values

D1 = 0; D2 = 8; D3 = 8; D4 = all bits set; D5 = all bits set.

Pixel plotting

As initial values.

Line drawing

D1 = the distance covered on the x or y axis, whichever is the greater; D2 = 2 * the distance on the other axis, then subtract D1; D3 = 2 * the shorter minus the longer distance;

D4 = 2 * the shorter of the two distances; D5 = initial setting. D2 and D3 require two's complement notation, other values are absolute. The Direction value for the Figure command must contain the octant in which line drawing is to take place.

Arc drawing

D1 = radius of curvature * sine of angle between major axis and end of arc (max. 45°); D2 = one pixel less than the radius of curvature; D3 = 2 * D2; D4 = all bits set; D5 = radius of curvature * sine of angle between major axis and beginning of arc (max. 45°), then rounded down to next integer.

Rectangle drawing

D1 = 3; D2 = number of pixels in direction specified in command byte, minus one; D3 = number of pixels in direction at right angle to direction specified in command byte, minus one; D4 = all bits set; D5 = D2.

Filling an area

D1 = one less than the number of pixels at right angle to direction specified in command byte; D2 = number of pixels in direction specified in command byte; D3 = D2.

Graphic Character

This process is really a case of area filling, where the number of pixels in each direction is < = 8. If that number in the direction specified in the command byte is 8, there is no need to load D2 and D3.

Writing data

D1 = number of display words required, minus 1. All other parameters are of no significance.

Write via DMA

D1 = number of words to be accessed in direction at right angle to direction specified in command byte, minus one; D2 = number of bytes to be transferred in the other direction, minus one; other parameters are not significant.

Read via DMA

D1 = number of words to be accessed in direction at right angle to direction specified in command byte; D2 = number of bytes to be transferred in the initially specified direction, minus two; D3 = D2/2 (required only for word read); D4 and D5 are not significant.

Read data via CPU

D1 = number of words to be accessed; other parameters are not significant.

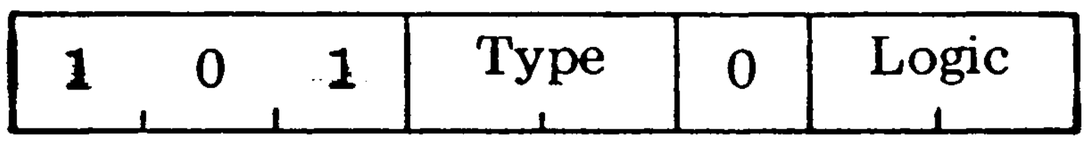
Draw — Command byte: 6CH, no parameters:

Drawing is started at the pixel indicated by the current cursor position, and in accordance with bytes 8 and 9 in the parameter RAM and the drawing parameters set by Figure.

Draw Graphics Character — Command byte: 68H, no parameters.

As in Draw, except that the 8 x 8 pixel pattern in parameter RAM bytes 8-15 is drawn.

Read Data from Graphic Display Memory — This command reverses the direction of the FIFO buffer if it has so far been used for transferring data to the GDC. This means the loss of any commands or parameters in the buffer which follow the Read Data command. The structure of the command byte is:



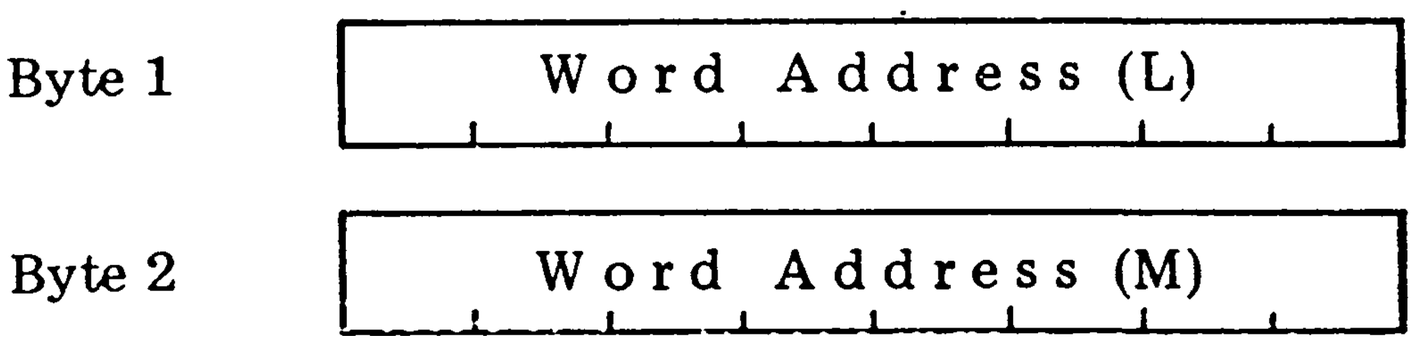
A zero value for Type denotes a word read (low then high). Value 2 indicates low byte of word only, value 3 high byte only. Value 1 is not valid. The Logic value (see Write Data) determines the state in which the graphic display memory will be after reading. Assuming that you wish only to read data and not modify them in any way, this value must be zero.

Reading data from graphic display memory requires that you state the number of words to be read by means of the Figure command. In addition you must set the Direction, and, if this is neither 0 nor 4, you should issue a Mask command with all the parameter bits set. Perhaps the most easily understandable Direction setting is 2, as this accesses the addresses in ascending order, i.e. left to right, then the next line down, and so on. Do not forget to ensure that the cursor is in the position where you wish reading to commence. It is also advisable to check the data ready status bit (bit 1) before each read.

Each byte of data can be read by the CPU at port A1, whereupon a further byte is loaded by the GDC into its FIFO buffer. A read sequence can be discontinued by transmitting a command to the GDC. Otherwise, reading is continued until D1 (see Figure command) decrements to zero.

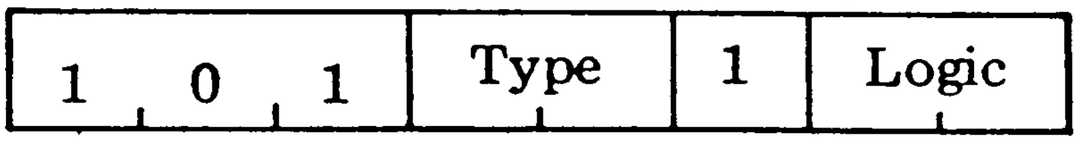
Read Current Address of Cursor — Command byte: 0E0H.

The cursor address is returned via the FIFO in the following format:

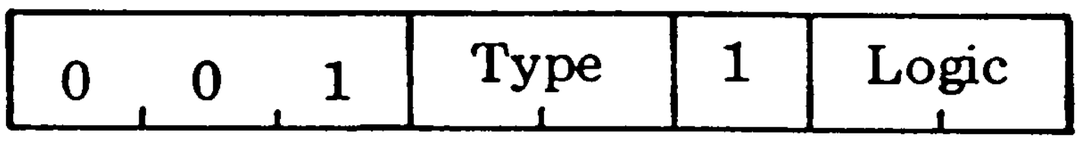


Note that the dot position is not represented by a binary value in 4 bits, but as one set bit among 15 zero bits.

DMA Transfer — Command byte for read request:



Command byte for write request:



The significance of Type and Logic bits is the same as for the Read Data command.

Before the transfer can be executed, the Figure command must be issued with appropriate parameters (see Figure). The cursor must be positioned and the Mask register bits must be all set. As DMA transfers bypass the FIFO buffer, its contents are not affected.

GDC Status Considerations

When transmitting data to the GDC, it is important that the FIFO buffer does not overflow. Checking status bit 1 before transmitting ensures that there is space in the FIFO for at least one command or parameter byte. Alternatively, the processor could wait for the buffer to become empty (status bit 2), and then transmit up to

16 bytes. Whichever method you choose, you should not transmit data to the GDC merely on the assumption that the FIFO buffer will have passed on some of its contents for execution. Especially during figure drawing there are always delays, during which no bytes are taken from the buffer.

The GDC makes use of a separate data register to help eliminate delays in providing data at the read port. Nonetheless, it is advisable to check bit 0 (data ready) of the GDC status. If you are using status bit 1 (FIFO full) to synchronize GDC data output with processor data reading, your program should not make an early termination (i.e. termination before D1 has decremented to zero) of the read sequence dependent on the FIFO buffer not being full. The status bit will not be reset as long as the buffer is full of read data, so if your new command byte is waiting for this bit to reset, your program will loop.

SOME GDC PROGRAMMING EXAMPLES

The assembly language routines contained in this section are designed to provide you with a starting point for the development of your own graphics. They include examples of how to set your cursor position, draw rectangles, arcs and circles, and how to do pixel by pixel drawing under keyboard control. Instructions are also given about how to read the character generator of the firmware ROM in your NCR DECISION MATE V, and how to store and restore your graphic designs. A number of arithmetic routines for pixel calculation are also included.

These and similar graphic routines can be written with the symbolic assembler provided with your operating system software. Following assembly, you can test and adapt the routines using the debugging utility which is also present on your operating system flexible disk.

The stage by stage program construction in this section introduces each DB, DW, or DS at the time of discussion of the first routine which makes use of that particular storage definition. Remember to include the ORG 100H directive at the beginning of the program.

```
0100                    ORG 100H
0100 0000       SPSTORE: DW 0
```

The 16-bit area SPSTORE is included in order to remind you to consider setting up your own user stack. This might become necessary if you intend to extend the graphics examples. You can

edit, assemble, and test the programs as described in the section "Some I/O Examples."

OUTC is a routine for transmitting a command byte to the GDC. Upon entry, the command byte must be in register A. Transmission takes place only when there is no drawing in progress and the FIFO buffer is capable of receiving at least one byte.

```
0102 F5          OUTC:    PUSH PSW
0103 DBA0        OUTC1:   IN 0A0H
0105 E60A                 ANI 0AH
0107 C20301               JNZ OUTC1
010A F1                   POP PSW
010B D3A1                 OUT 0A1H
010D C9                   RET
```

OUTP transmits a number of parameters. Upon entry, the number of parameters must be contained in register C, the first parameter must be addressed by HL.

```
010E DBA0        OUTP:    IN 0A0H
0110 E60A                 ANI 0AH
0112 C20E01               JNZ OUTP
0115 7E          OUTP1:   MOV A,M
0116 D3A0                 OUT 0A0H
0118 23                   INX H
0119 0D                   DCR C
011A C21501               JNZ OUTP1
011D C9                   RET
```

Therefore, you could arrange parameters for graphics initialization as follows:

```
011E 00          PRAMS:   DB 0
011F 08                   DB 8
0120 0000005900PRAMS1:    DB 0,0,0,59H,0,0,0,59H,0FFH,0FFH,0FFH,0FFH,0FFH,
                             0FFH,0FFH,0FFH
0130 000000      PRAMS2:  DB 0,0,0
0133 FFFF        PRAMS3:  DB 0FFH,0FFH
0135 02FF7F0800PRAMS4:    DB 2,0FFH,7FH,8,0,8,0,0FFH,3FH,0FFH,3FH
0140 FFFF        PRAMS5:  DB 0FFH,0FFH
0142 21          WRLOGIC: DB 21H          ;complement
```

GINIT is the routine which transmits these parameters:

```
0143 211E01    GINIT:   LXI H,PRAMS
0146 3E0C               MVI A,0CH      ;bit 0 blanks screen
0148 CD0201             CALL OUTC
014B 3E46               MVI A,46H      ;set zoom to zero
014D CD0201             CALL OUTC
0150 0E01               MVI C,1
0152 CD0E01             CALL OUTP
0155 3E4B               MVI A,4BH      ;cursor/char charecs
0157 CD0201             CALL OUTC
015A 0E01               MVI C,1        ;sets lines per row to
                                       ;zero for graphics.
015C CD0E01             CALL OUTP
015F 3E70               MVI A,70H      ;load entire parameter
                                       ;RAM.
0161 CD0201             CALL OUTC
0164 0E10               MVI C,10H
0166 212001             LXI H,PRAMS1
0169 CD0E01             CALL OUTP      ;sets graphics and 400
                                       ;pixels vertical.
016C 3E49               MVI A,49H      ;set cursor pos
016E CD0201             CALL OUTC
0171 0E03               MVI C,3
0173 213001             LXI H,PRAMS2
0176 CD0E01             CALL OUTP      ;first pixel for drawing.
0179 3E4A               MVI A,4AH      ;set mask
017B CD0201             CALL OUTC
017E 0E02               MVI C,2
0180 213301             LXI H,PRAMS3
0183 CD0E01             CALL OUTP
0186 3E4C               MVI A,4CH      ;fig parameters
0188 CD0201             CALL OUTC
018B 0E0B               MVI C,0BH
018D 213501             LXI H,PRAMS4
0190 CD0E01             CALL OUTP      ;no geom. figs
                                       ;direction east.
0193 3E22               MVI A,22H      ;write data word high
                                       ;then low, reset to zero.
0195 CD0201             CALL OUTC
0198 0E02               MVI C,2
019A 214001             LXI H,PRAMS5
019D CD0E01             CALL OUTP
```

```
01A0 3E21              MVI A,21H     ;write data, this time
                                     ;complement.
01A2 324201            STA WRLOGIC
01A5 CD0201            CALL OUTC
01A8 3E0D              MVI A,0DH     ; re-enable screen
01AA CD0201            CALL OUTC
01AD CDB601    WAIT:   CALL GETKEY
01B0 FE24              CPI '$'
01B2 C2AD01            JNZ WAIT
01B5 C9                RET
```

Command 0CH blanks the screen. The first parameter at PRAMS is used for setting zoom to zero, the second sets the number of display lines per character row to zero. Command 70H means start loading the parameter RAM at the first byte. The parameters used (PRAMS1) set up one display partition, starting at the address zero in graphic display memory with length 400 (display lines). The remaining parameters are initialized to all bits set. This is of significance in the case of parameter RAM bytes 8 and 9, as this will ensure that figure drawing is carried out with unbroken lines. Command 49H sets the cursor to the beginning of the display area. Remember that this corresponds to the top left corner on the CRT. If you wish to use Cartesian coordinates, your programs will require additional calculations. Command 4AH uses PRAMS3 to set the mask register with all bits set. PRAMS4 contains the initial values for figure drawing (dot drawing, direction East). Command 22H uses PRAMS5 and the Logic setting 2 (reset to zero) to set the entire bit-map to zero. Command 21H sets the complement Logic for future drawing and writing. This state of Logic is also recorded in the byte WRLOGIC. Finally, the screen is re-enabled.

Further processing is now dependent on entering $ at the keyboard. The GETKEY routine for reading the keyboard must be careful not to attempt to output a character to the CRT, once the GDC is in graphics mode. In order to suppress this screen echo, the direct I/O function of the operating system is used. This routine will be invaluable in the keyboard-controlled drawing described later. GETKEY returns the key pressed in register A.

```
0186 C5        GETKEY: PUSH B
0187 D5                PUSH D
0188 0E06              MVI C,6
018A 1EFF              MVI E,0FFH
018C CD0500            CALL 0005
```

```
01BF D1                 POP D
01C0 C1                 POP B
01C1 C9                 RET
```

Assuming that you wish to return to normal character writing after completion of your graphics routines, you require an exit routine to restore the status prior to graphic processing. This routine is at any rate to be recommended when using the debugging tool, so that you can inspect registers and memory afterwards. The parameters starting at EXPRAMS are used by the exit routine GEXIT.

```
01C2 8F00       EXPRAMS:DB 8FH,0
01C4 00900001001EXPRAMS1: DB 0,90H,0,1,0,0FFH,0FFH,0FFH,0FFH,0FFH,0FFH,
                          0FFH,0FFH
01D1 21C201     GEXIT:    LXI H,EXPRAMS :exit routine
01D4 3E4B                 MVI A,4BH
01D6 CD0201               CALL OUTC
01D9 0E01                 MVI C,1
01DB CD0E01               CALL OUTP
01DE 3E46                 MVI A,46H
01E0 CD0201               CALL OUTC
01E3 0E01                 MVI C,1
01E5 CD0E01               CALL OUTP
01E8 3E70                 MVI A,70H
01EA CD0201               CALL OUTC
01ED 0E0D                 MVI C,0DH
01EF CD0E01               CALL OUTP
01F2 1E1A                 MVI E,1AH
01F4 0E02                 MVI C,2
01F6 CD0500               CALL 0005
01F9 C9                   RET
```

Command 4BH resets the number of display lines per character row to 16. 46H ensures that zoom is set to zero. Following this, the parameter RAM bytes are set. The IM bit is now reset, so that graphics display memory is no longer to be regarded as bit-mapped. Finally, the screen is cleared and the cursor set top left.

As the next stage, we can reserve an area for cursor position (CURPRAMS) and create a routine, CURSET, for transmitting that position to the GDC. CURPRAMS contains in 2 bytes (lower location = less significant byte) the word position, the third byte (highest location) must contain in its four uppermost bits the dot

address within that word (see Position Cursor). The values used here in the DB directives will place the cursor 131,584 pixels from the beginning of display memory (no special significance to this value), that is, approximately halfway along the 206th line of the 400 line display.

```
01FA 20        CURPRAMS: DB 20H
01FB 20                  DB 20H
01FC 00                  DB 0
01FD 3E49      CURSET:   MVI A,49H
01FF CD0201              CALL OUTC
0202 21FA01              LXI H,CURPRAMS
0205 0E03                MVI C,3
0207 CD0E01              CALL OUTP
```

Now reserve an area for storing figure drawing parameters:

```
020A C9                  RET
020B           FIGPRAMS: DS 11
```

Enter the routine for transmitting these parameters to the GDC

```
0216 3E4C      FIGSET:   MVI A,4CH
0218 CD0201              CALL OUTC
021B 210B02              LXI H,FIGPRAMS
021E 0E0B                MVI C,0BH
0220 CD0E01              CALL OUTP
0223 C9                  RET
```

and the command which sets drawing in progress.

```
0224 3E6C      FIGDRAW:  MVI A,6CH
0226 CD0201              CALL OUTC
0229 C9                  RET
```

All that is now required are actual parameters for figure drawing. The following can be used for drawing a square:

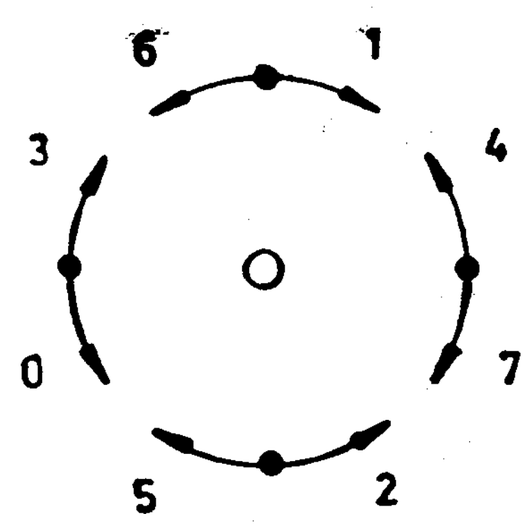
```
022A 40034030000FIGPRAM1: DB 40H,3,40H,30H,0,30H,0,0FFH,3FH,30H,0
```

The routines described hitherto can now be used in a program to draw a square. First, the actual parameters in FIGPRAM1 are

copied to the 11-byte FIGPRAMS area, as this is where the FIGSET routine expects to find them. Then the GDC is set up for graphics. Enter $, whereupon the cursor is set and the figure drawn. The figure will remain on the screen until you enter x. After the initial run, you may wish to experiment with the values in CURPRAMS and FIGPRAM1.

```
0235 212A02             LXI H,FIGPRAM1
0238 110B02             LXI D,FIGPRAMS
023B 0E0B               MVI C,0BH
023D 7E         NEXTPR1: MOV A,M
023E 12                 STAX D
023F 23                 INX H
0240 13                 INX D
0241 0D                 DCR C
0242 C23D02             JNZ NEXTPR1
0245 CD4301             CALL GINIT
0248 CDFD01             CALL CURSET
024B CD1602             CALL FIGSET
024E CD2402             CALL FIGDRAW
0251 CD8601     WAIT2:  CALL GETKEY
0254 FE78               CPI 'x'
0256 C25102             JNZ WAIT2
0259 CDD101             CALL GEXIT
```

To draw a circle, it is necessary to draw 8 arcs each turning through 45°. The arcs are drawn from four points around the centre of the circle, using the following Direction values:



Begin by setting up the data storage areas as follows:

```
025C 40BE       MIDDLE   DW 0BE40H
025E 01         MIDDLEH  DB 1
025F 32         RADIUS   DB 50
0260 0000       NORTH    DW 0
```

```
0262 00         NORTHH   DB 0
0263 0000       SOUTH    DW 0
0265 00         SOUTHH   DB 0
0266 0000       EAST     DW 0
0268 00         EASTH    DB 0
0269 0000       WEST     DW 0
026B 00         WESTH    DB 0
026C 0000       PIXEL    DW 0
026E 00         PIXELH   DB 0
026F 00         CURSL    DB 0
0270 00         CURSH    DB 0
0271 00         DOTPOS   DB 0
```

The first three bytes contain the pixel position in up to 18 bits (MIDDLEH = most significant byte, upper 6 bits reset) of the centre of the circle. The initial values used here place this point approximately halfway along the 179th display line. Using this position and RADIUS, the North, South, East, and West points on the circumference of the circle can be calculated. These pixel values are returned in NORTH, NORTHH, etc. as 3-byte values, the third byte in each case being the most significant byte. Do not, for the moment, alter the value in RADIUS.

```
0272 E5         COMPASS: PUSH H
0273 D5                  PUSH D
0274 C5                  PUSH B
0275 3A5E02              LDA MIDDLEH
0278 326202              STA NORTHH
027B 326502              STA SOUTHH
027E 326802              STA EASTH
0281 326B02              STA WESTH
0284 018002              LXI B,280H   ;pitch
0287 215F02              LXI H,RADIUS
028A 5E                  MOV E,M
028B 2A5C02     CNORTH:  LHLD MIDDLE
028E 53                  MOV D,E
028F 37         NDCR:    STC
0290 3F                  CMC
0291 ED42                DB 0EDH,42H  ;Z-80 SBC HL,BC
0293 3A6202              LDA NORTHH
0296 DE00                SBI 0
0298 326202              STA NORTHH
029B 15                  DCR D
029C C28F02              JNZ NDCR
```

```
029F 226002             SHLD NORTH
02A2 2A5C02    CSOUTH:  LHLD MIDDLE
02A5 53                 MOV D,E
02A6 37        SDCR:    STC
02A7 3F                 CMC
02A8 ED4A               DB 0EDH,4AH  ;Z-80 ADC HL,BC
02AA 3A6502             LDA SOUTHH
02AD CE00               ACI 0
02AF 326502             STA SOUTHH
02B2 15                 DCR D
02B3 C2A602             JNZ SDCR
02B6 226302             SHLD SOUTH
02B9 2A5C02    CEAST:   LHLD MIDDLE
02BC 53                 MOV D,E
02BD 010100             LXI B,1
02C0 37        EDCR:    STC
02C1 3F                 CMC
02C2 ED4A               DB 0EDH,4AH
02C4 3A6802             LDA EASTH
02C7 CE00               ACI 0
02C9 326802             STA EASTH
02CC 15                 DCR D
02CD C2C002             JNZ EDCR
02D0 226602             SHLD EAST
02D3 2A5C02    CWEST:   LHLD MIDDLE
02D6 53                 MOV D,E
02D7 37        WDCR:    STC
02D8 3F                 CMC
02D9 ED42               DB 0EDH,42H  ;Z-80 ADC HL,BC
02DB 3A6B02             LDA WESTH
02DE DE00               SBI 0
02E0 326B02             STA WESTH
02E3 15                 DCR D
02E4 C2D702             JNZ WDCR
02E7 226902             SHLD WEST
02EA C1                 POP B
02EB D1                 POP D
02EC E1                 POP H
02ED C9                 RET
```

The following routine is useful for converting a 3-byte pixel value into a format appropriate to the Position Cursor command, that is, as a 16-bit word address and one additional byte with a 4-bit dot-position value in bits 4-7. Upon entry to WORDAD, the

pixel value must be available in PIXEL and (most significant) PIXELH. The word address and dot position will be returned in CURSL (least significant) and CURSH, with the dot position in DOTPOS.

```
02EE E5          WORDAD:   PUSH H
02EF D5                    PUSH D
02F0 C5                    PUSH B
02F1 216C02                LXI H,PIXEL
02F4 7E                    MOV A,M
02F5 07                    RLC
02F6 07                    RLC
02F7 07                    RLC
02F8 07                    RLC
02F9 47                    MOV B,A
02FA E6F0                  ANI 0F0H
02FC 327102                STA DOTPOS
02FF 78                    MOV A,B
0300 E60F                  ANI 0FH
0302 326F02                STA CURSL
0305 216C02                LXI H,PIXEL
0308 23                    INX H
0309 7E                    MOV A,M
030A 07                    RLC
030B 07                    RLC
030C 07                    RLC
030D 07                    RLC
030E 47                    MOV B,A
030F E6F0                  ANI 0F0H
0311 216F02                LXI H,CURSL
0314 B6                    ORA M
0315 326F02                STA CURSL
0318 78                    MOV A,B
0319 E60F                  ANI 0FH
031B 327002                STA CURSH
031E 216E02                LXI H,PIXELH
0321 7E                    MOV A,M
0322 CB27                  DB 0CBH,27H  ;Z-80 SLA A
0324 CB27                  DB 0CBH,27H
0326 CB27                  DB 0CBH,27H
0328 CB27                  DB 0CBH,27H
032A 217002                LXI H.CURSH
032D B6                    ORA M
032E 77                    MOV M.A
```

```
032F C1          POP B
0330 D1          POP D
0331 E1          POP H
0332 C9          RET
```

The next routine, CURTRANSF, does no more than copy at CURPRAMS the cursor position in CURSL, CURSH, and DOTPOS. This means that the cursor position calculated by WORDAD can be used by the CURSET routine.

```
0333 E5       CURTRANSF: PUSH H
0334 2A6F02              LHLD CURSL
0337 22FA01              SHLD CURPRAMS
033A 3A7102              LDA DOTPOS
033D 21FA01              LXI H,CURPRAMS
0340 23                  INX H
0341 23                  INX H
0342 77                  MOV M,A
0343 E1                  POP H
0344 C9                  RET
```

The program to draw two 45° arcs, one on each side of the northmost point of the circumference, can now be put together. The initialization of the graphics mode is the same procedure as when drawing the rectangle. Following this, COMPASS calculates pixel values for the North, South, East, and West positions. The word address is calculated for North and placed at CURPRAMS so that the cursor can be set:

```
0345 CD4301              CALL GINIT
0348 CD7202              CALL COMPASS
034B 2A6002              LHLD NORTH
034E 226C02              SHLD PIXEL
0351 3A6202              LDA NORTHH
0354 326E02              STA PIXELH
0357 CDEE02              CALL WORDAD
035A CD3303              CALL CURTRANSF
035D CDFD01              CALL CURSET
```

The next step is to set up FIGPRAMS with the parameter for figure drawing. Note that drawing parameters D1, D2, D3, and D5 contain values which apply specifically to the chosen radius of 50 pixels. Therefore, if you change the radius, you will have to adjust these parameters or write a routine to do this for you.

The most interesting parameter in FIGPRAMS is the first. The bit for arc drawing remains set throughout the program but the three Direction bits require different values between 0 and 7, depending on the arc to be drawn (see figure immediately following the rectangle program). The values for drawing the two arcs from the North point are 1 and 6. This program draws the Direction 1 arc first.

```
0360 210B02             LXI H,FIGPRAMS
0363 3621               MVI M,21H     ;type of drawing = arc,
                                      ;direction = 1.
0365 23                 INX H
0366 3623               MVI M,23H     ;rsin 45 for radius
                                      ;50 pixels.
0368 23                 INX H
0369 3640               MVI M,40H     ;graphics drawing flag
036B 23                 INX H
036C 3631               MVI M,31H     ;one less than radius
036E 23                 INX H
036F 3600               MVI M,0       ;upper bits zero
0371 23                 INX H
0372 3662               MVI M,62H     ;2 * (radius-1)
0374 23                 INX H
0375 3600               MVI M,0       ;upper bits zero
0377 23                 INX H
0378 36FF               MVI M,0FFH    ;D4
037A 23                 INX H
037B 363F               MVI M,3FH     ;D4 upper bits
037D 23                 INX H
037E 3600               MVI M,0       ;D5
0380 23                 INX H
0381 3600               MVI M,0
                ;
0383 CD1602             CALL FIGSET
0386 CD2402             CALL FIGDRAW
```

Then follows the Direction 6 arc:

```
0389 CDFD01             CALL CURSET
038C 210B02             LXI H,FIGPRAMS
038F 3626               MVI M,26H
0391 CD1602             CALL FIGSET
0394 CD2402             CALL FIGDRAW
```

Once the arcs at the point North on the circumference have been drawn, the program can proceed to convert the pixel value for South into a cursor position, set the cursor position, and draw the southern arcs. The two arcs at East and the two arcs at West are drawn in the same way.

```
0397 2A6302             LHLD SOUTH
039A 226C02             SHLD PIXEL
039D 3A6502             LDA SOUTHH
03A0 326E02             STA PIXELH
03A3 CDEE02             CALL WORDAD
03A6 CD3303             CALL CURTRANSF
03A9 CDFD01             CALL CURSET
03AC 210B02             LXI H,FIGPRAMS
03AF 3622               MVI M,22H
03B1 CD1602             CALL FIGSET
03B4 CD2402             CALL FIGDRAW
03B7 CDFD01             CALL CURSET
03BA 210B02             LXI H,FIGPRAMS
03BD 3625               MVI M,25H
03BF CD1602             CALL FIGSET
03C2 CD2402             CALL FIGDRAW
                        ;
03C5 2A6602             LHLD EAST
03C8 226C02             SHLD PIXEL
03CB 3A6802             LDA EASTH
03CE 326E02             STA PIXELH
0301 CDEE02             CALL WORDAD
0304 CD3303             CALL CURTRANSF
0307 CDFD01             CALL CURSET
030A 210B02             LXI H,FIGPRAMS
030D 3624               MVI M,24H
030F CD1602             CALL FIGSET
03E2 CD2402             CALL FIGDRAW
03E5 CDFD01             CALL CURSET
03E8 210B02             LXI H,FIGPRAMS
03EB 3627               MVI M,27H
03ED CD1602             CALL FIGSET
03F0 CD2402             CALL FIGDRAW
                        ;
03F3 2A6902             LHLD WEST
03F6 226C02             SHLD PIXEL
03F9 3A6B02             LDA WESTH
03FC 326E02             STA PIXELH
```

```
03FF CDEE02             CALL WORDAD
0402 CD3303             CALL CURTRANSF
0405 CDFD01             CALL CURSET
0408 210B02             LXI H,FIGPRAMS
040B 3620               MVI M,20H
040D CD1602             CALL FIGSET
0410 CD2402             CALL FIGDRAW
0413 CDFD01             CALL CURSET
0416 210B02             LXI H,FIGPRAMS
0419 3623               MVI M,23H
041B CD1602             CALL FIGSET
041E CD2402             CALL FIGDRAW
```

The circle will remain on the screen until you press x:

```
0421 CD8601     WAIT3:  CALL GETKEY
0424 FE78               CPI 'x'
0426 C22104             JNZ WAIT3
0429 CDD101             CALL GEXIT
```

The next example of programming the GDC in your NCR DECISION MATE V gives you the possibility of doing pixel by pixel drawing, by using the keys around the 5 key on the calculator pad situated on the right of the keyboard. Depressing the 8 key will plot one pixel north of the last pixel plotted; depressing the 9 key will plot a pixel north-east of the last pixel plotted, and so on. Pressing the 5 key will effect unplot instead of plot. In this way, you can move the plot position without actually plotting. To see where you are on the screen, press 5 and plot a point. If this is not where you want to be, press 5 again and retrace the last movement to erase the pixel plotted. Enter 0 and then x to leave the program.

The following routine reads the keyboard, and, upon receiving a valid entry 1-9, sets the Direction bits in the first byte of FIGPRAMS accordingly. Note that the numbers on the calculator pad require translation before they can be used as Direction values. The part of the routine at ONOFF (executed if 5 is pressed) executes a GDC Write Data command using the byte stored at WRLOGIC (defined at the beginning of the programming session) as a toggle: if the set Logic is active, then it is replaced by reset Logic, and vice-versa.

```
042C CDB601    CALCUL:   CALL GETKEY
042F 1600                MVI D,0
0431 FE30                CPI '0'
0433 CA6904              JZ OVER
0436 210B02              LXI H,FIGPRAMS
0439 FE35                CPI '5'
043B CA7C04              JZ ONOFF
043E FE31                CPI '1'
0440 CA6A04              JZ DIR7
0443 FE32                CPI '2'
0445 CA7104              JZ DIR0
0448 FE33                CPI '3'
044A CA7004              JZ DIR1
044D FE34                CPI '4'
044F CA6B04              JZ DIR6
0452 FE36                CPI '6'
0454 CA6F04              JZ DIR2
0457 FE37                CPI '7'
0459 CA6C04              JZ DIR5
045C FE38                CPI '8'
045E CA6D04              JZ DIR4
0461 FE39                CPI '9'
0463 CA6E04              JZ DIR3
0466 C32C04              JMP CALCUL
0469 C9        OVER:     RET
046A 14        DIR7:     INR D
046B 14        DIR6:     INR D
046C 14        DIR5:     INR D
046D 14        DIR4:     INR D
046E 14        DIR3:     INR D
046F 14        DIR2:     INR D
0470 14        DIR1:     INR D
0471 00        DIR0:     NOP
0472 72                  MOV M,D
0473 CD1602              CALL FIGSET
0476 CD2402              CALL FIGDRAW
0479 C32C04              JMP CALCUL
                  ;
047C 3A4201    ONOFF:    LDA WRLOGIC
047F EE01                XRI 1
0481 324201              STA WRLOGIC
0484 CD0201              CALL OUTC
0487 C32C04              JMP CALCUL
```

For pixel by pixel drawing, the "initial values" stated in the description of the GDC Figure command should be set:

```
048A 0000400800FIGPRAM2: DB 0,0,40H,8,0,8,0,0FFH,3FH,0FFH,3FH
```

To do this, the program first copies FIGPRAM2 to FIGPRAMS. Set the cursor at CURPRAMS (this time the program does not do this for you) before CURSET is called. The GDC command byte 23H changes the drawing Logic from its initialization setting of "complement" to "set to 1." This means that if lines cross during drawing, pixel erasure will not occur. If this GDC command is omitted, ONOFF will not work properly. The instruction pointer will not leave CALCUL until you press 0. The "complement" setting of the drawing Logic is then restored. The JMP SAVEIT instruction applies to a program extension described later. For the moment, this instruction should read JMP SAVED.

```
0495 218A04             LXI H,FIGPRAM2
0498 110802             LXI D,FIGPRAMS
049B 0E0B               MVI C,0BH
049D 7E       NEXTPR2:  MOV A,M
049E 12                 STAX D
049F 23                 INX H
04A0 13                 INX D
04A1 0D                 DCR C
04A2 C29D04             JNZ NEXTPR2
04A5 CD4301             CALL GINIT
04A8 CDFD01             CALL CURSET
04AB 3E23               MVI A,23H
04AD 324201             STA WRLOGIC
04B0 CD0201             CALL OUTC
04B3 CD2C04             CALL CALCUL
04B6 CD8601   WAIT4:    CALL GETKEY
04B9 FE78               CPI 'x'
04BB C2B604             JNZ WAIT4
04BE 3E21               MVI A,21H
04C0 324201             STA WRLOGIC
04C3 CD0201             CALL OUTC     ;resets to complement
                                      ;at any rate.
04C6 C3F660             JMP SAVEIT    ;JMP SAVED
04C9 CD0101   SAVED:    CALL GEXIT
```

The character set of your NCR DECISION MATE V is stored in the ROM which executes power-up initialization. The characters are stored in ascending ASCII sequence from location 1000H onwards. Each character is stored in 16 bytes, representing 16 horizontal line scans. In order to read a portion of the ROM, you must activate Port 11 (Hex), which acts as a ROM-select switch. To switch back to user RAM, Port 10 (Hex) must be activated. While the ROM is selected, the RAM below location 2000H is de-selected. This means that the part of your program which reads the ROM must be located at or above that address. In addition, you must not attempt to use the BDOS entry facility (CALL 0005) while the ROM is selected, otherwise program control will be lost.

CHSTORE is to be used for storing the 16-byte character pattern immediately upon being read from the ROM:

```
2100                    ORG 2100H
2100          CHSTORE:  DS 16
```

The following routine, ASCII, fetches a 16 x 8 bit pattern from the ROM and deposits it in the 16-byte storage area CHSTORE. Upon entry, register A must contain the ASCII character for which the bit pattern is required. The binary value of the ASCII character is multiplied by 16, the result residing in HL. The start address of the character area in the ROM is added to this, thus HL addresses the first of the 16 bytes containing the bit pattern. These bytes are then copied via register A to CHSTORE.

```
2110 C5         ASCII:    PUSH B
2111 D5                   PUSH D
2112 E5                   PUSH H
2113 6F                   MOV L,A
2114 2600                 MVI H,0
2116 29                   DAD H
2117 29                   DAD H
2118 29                   DAD H
2119 29                   DAD H
211A 110010               LXI D,1000H
2110 19                   DAD D          ;ROM char address in HL
211E 110021               LXI D,CHSTORE
2121 0610                 MVI B,10H
2123 D311                 OUT 11H
2125 7E         ROMBYTE:  MOV A,M
2126 12                   STAX D
```

```
2127 23          INX H
2128 13          INX D
2129 05          DCR B
212A C22521      JNZ ROMBYTE
212D D310        OUT 10H
212F E1          POP H
2130 D1          POP D
2131 C1          POP B
2132 C9          RET
```

The following two program lines make a copy of the bit pattern of the number 7:

```
2133 3E37        MVI A,'7'
2135 CD1021      CALL ASCII
```

If you write out the bit pattern contained in CHSTORE, you will see that the least significant bit of each byte contains the leftmost pixel of the line scan for that byte.

The GDC parameter RAM provides a comfortable means of creating your own user-defined graphic symbols. An 8 x 8 pixel design stored in bytes 8-15 of the parameter RAM can be output as often as you wish.

You may find the two following routines useful. The first sets a zoom factor for the CRT representation of the graphic symbol contained in the parameter RAM. This zoom factor (0-15) must be available in the lower four bits of a single byte area, ZOOMFACT.

```
2138 04          ZOOMFACT: DB 4
2139 3E46        ZOOM:     MVI A,46H
213B CD0201                CALL OUTC
213E 213821                LXI H,ZOOMFACT
2141 0E01                  MVI C,1
2143 CD0E01                CALL OUTP
2146 C9                    RET
```

The second routine, SKEW, produces in CHARMIR a mirror image of each byte of an 8 x 8 design stored in CHARPATT. This design is thus copied "back to front." Furthermore, the byte sequence is inverted.

```
2147 005A427E3C24CHARPATT: DB 0,5AH,42H,7EH,3CH,24H,24H,42H
                                                ;random example
214F               CHARMIR:  DS 8
```

```
                        ;
2157 214721     SKEW:   LXI H,CHARPATT
215A 0600               MVI B,0
215C 0E07               MVI C,7
215E 09                 DAD B          ;HL points to 8th byte
215F 114F21             LXI D,CHARMIR ;DE points to first byte
2162 0E08               MVI C,8
2164 7E         NEXTCH: MOV A,M
2165 CD7021             CALL MIRROR    ;to cancel mirror,
                                       ;replace CALL
2168 12                 STAX D         ;instruction with 3 NOPs
2169 2B                 DCX H
216A 13                 INX D
216B 0D                 DCR C          ;until all 8 bytes
                                       ;inverted and mirrored.
216C C26421             JNZ NEXTCH
216F C9                 RET
                        ;
2170 C5         MIRROR: PUSH B
2171 D5                 PUSH D
2172 E5                 PUSH H
2173 57                 MOV D,A
2174 21AD21             LXI H,TESTVAR
2177 3E82               MVI A,82H
2179 77                 MOV M,A
217A 21B221             LXI H,SETVAR
217D 3EB8               MVI A,0B8H
217F 77                 MOV M,A
2180 21B521             LXI H,RESVAR
2183 3E78               MVI A,78H
2185 77                 MOV M,A
2186 0E08               MVI C,8
2188 3AAD21     NEXTBIT: LDA TESTVAR   ;the Z-80 BIT, SET and
218B D608               SUI 8          ;RESET instructions con-
218D 32AD21             STA TESTVAR    ;tained as DBs in the
2190 3AB221             LDA SETVAR     ;TESTB routine are modi-
2193 C608               ADI 8          ;fied dynamically eight
2195 32B221             STA SETVAR     ;times. Each bit of reg.
2198 3AB521             LDA RESVAR     ;D is tested, and its
219B C608               ADI 8          ;mirror counterpart in B
219D 32B521             STA RESVAR     ;(e.g. bit 6 for bit 1)
21A0 CDAC21             CALL TESTB     ;is set to the value of
21A3 0D                 DCR C          ;the tested bit
21A4 C28821             JNZ NEXTBIT
```

```
21A7 78                 MOV A,B
21A8 E1                 POP H
21A9 D1                 POP D
21AA C1                 POP B
21AB C9                 RET
21AC CB         TESTB:  DB 0CBH
21AD            TESTVAR: DS 1
21AE CAB421             JZ RESB
21B1 CB         SETB:   DB 0CBH
21B2            SETVAR: DS 1
21B3 C9                 RET
21B4 CB         RESB:   DB 0CBH
21B5            RESVAR: DS 1
21B6 C9                 RET
```

The CHAROUT routine loads the 8 x 8 pattern contained in CHARMIR into bytes 8-15 of the GDC parameter RAM. Following this, the parameters for the GDC Figure command and the zoom factor are set. The Figure parameters

```
21B7 16074007000CHFGPRAM: DB 16H,7,40H,7,0
                                        ;set slnt with bit 7
                                        ;in byte 1.
```

indicate in byte 1 that a non-slanting graphics character with initial drawing direction 6 is to be created. Byte 2 contains the number of pixels, minus 1. The only significance to byte 3 is that the graphics bit is set. Bytes 4 and 5 conclude the setting of the graphics character window as 8 x 8 pixels. Command byte 68H finally draws the character, using the magnification factor placed by CHAROUT in ZOOMFACT.

```
21BC 3E78       CHAROUT: MVI A,78H      ;starter in prom at
                                        ;parm 8.
21BE CD0201              CALL OUTC
21C1 214F21              LXI H,CHARMIR
21C4 0E08                MVI C,8
21C6 CD0E01              CALL OUTP
21C9 3E4C                MVI A,4CH      ;figset
21CB CD0201              CALL OUTC
21CE 21B721              LXI H,CHFGPRAM
21D1 0E05                MVI C,5
21D3 CD0E01              CALL OUTP
```

```
2106 3E04               MVI A,4
2108 323821             STA ZOOMFACT
210B CD3921             CALL ZOOM
210E 3E68               MVI A,68H     ;graphic character draw
2110 CD0201             CALL OUTC
2113 C9                 RET
```

You can put these routines together in the following program. The number 7 is copied from the ROM into CHSTORE. The first three and the last four bytes of CHSTORE contain zero, representing line scans for that character in which no pixels are drawn. The number 7, like many characters in the character set, is nine pixels high, so it will not fit into the GDC parameter RAM. In fact, the bottom of the 7 is truncated during the 8-byte transfer from CHSTORE to CHARPATT in this example. You can get around this problem in graphics mode character writing by transmitting the entire 16-byte in two stages to the GDC parameter RAM (this is how your NCR DECISION MATE V uses the GDC for screen writing in the non-graphics mode), or by simply plotting the character pixel by pixel. For user-defined graphics, this additional programming is not necessary, provided that you can fit all the dots (set bits) into the 8 x 8 format. This program writes copies of the character below one another, if you press the r key. The reason for the position of the next copy becomes apparent if you consider the order in which the bits of the parameter RAM are transmitted (see "The Parameter RAM") and the direction set by CHFGPRAM. By way of extending this program, you may wish to include a cursor positioning facility.

```
21E4 CD4301             CALL GINIT
21E7 CDFD01             CALL CURSET
21EA 3E37               MVI A,'7'
21EC CD1021             CALL ASCII
21EF 210021             LXI H,CHSTORE
21F2 23                 INX H           ;does not copy
21F3 23                 INX H           ;entire character
21F4 23                 INX H
21F5 114721             LXI D,CHARPATT
21F8 0E08               MVI C,8
21FA 7E         NEXTCOP: MOV A,M
21FB 12                 STAX D
21FC 23                 INX H
21FD 13                 INX D
21FE 0D                 DCR C
```

```
21FF C2FA21             JNZ NEXTCOP
2202 CD5721             CALL SKEW
2205 CDBC21   REPEAT:   CALL CHAROUT
2208 CDB601   WAIT5:    CALL GETKEY
2208 FE72               CPI 'r'
2200 CA0522             JZ REPEAT
2210 FE78               CPI 'x'
2212 C20822             JNZ WAIT5
2215 CD0101             CALL GEXIT
```

By altering the parameters for the GDC Figure command and blanking out the CALL SKEW and CALL MIRROR instructions, you can create some interesting effects.

Finally, let us look at an example of reading the graphic display memory. This facility of the GDC enables you to store graphic designs in such a way that they can be reproduced on the screen at a later time. The following routines enable you to copy graphics display memory contents into user memory. Once they are in user memory, you can easily adjust the graphic image, and then re-write to graphic display memory or store on disk. In everyday practice you will probably read and store blocks of GDC memory in multiples of the disk record size. The routines described here read one half of the graphic display memory for a monochrome CRT into user memory. This is to facilitate manipulation of the graphic image. If your NCR DECISION MATE V has a memory greater than 64KB, you can read the entire graphic bit map (32000 bytes). This is even possible in the 64KB memory. However, if the operating system and the debugging utility are to be retained in memory, this leaves little memory space for other programs.

The data areas required:

```
2218 FFFF       PRAMSR:   DB OFFH,OFFH
221A FFFF       RMASK:    DB OFFH,OFFH
221C 02084008000FIGSR:    DB 2,8,40H,8,0,8,0,0FFH,3FH,0FFH,3FH
2227 02         MASKFIG:  DB 2
2228            SCREEN:   DS 16000
60A8 FFFF       DUMBYTES: DB OFFH,OFFH
```

When you have completed a screen drawing using the pixel by pixel drawing facility described earlier in these GDC programming examples, you probably want to save your graphic design. This must be done before your program leaves the graphic mode, as the GEXIT routine sets the graphics display memory to

zero. Therefore, you should insert an instruction before or in place of the CALL GEXIT instruction at the end of the pixel by pixel drawing program, in order to jump first to the program which saves your graphic design: JMP SAVEIT.

Before looking at the SAVEIT program, let us consider three routines which govern the GDC commands and parameters required for reading graphic display memory. The READSCRN routine reads eight 16-bit words of graphic display memory (the size of the FIFO buffer) into user memory via the port A1. Before reading each byte, bit zero of the GDC status register is read, in order to check whether a data byte is available. As soon as a byte is read, this bit resets to zero and remains zero until the next data byte is available from the FIFO buffer. The speed of this resetting to zero is sufficiently high to prevent an unwanted second reading of the same data byte. As each byte is read, it is stored at a memory address pointed to by the HL register, and that register is then incremented.

```
60AA C5          READSCRN: PUSH B
60AB 0E08                  MVI C,8
60AD 1602        NEXTWORD: MVI D,2
60AF DBA0        READYCHK: IN 0A0H
60B1 E601                  ANI 1
60B3 CAAF60                JZ READYCHK
60B6 DBA1                  IN 0A1H
60B8 77                    MOV M,A
60B9 23                    INX H
60BA 15                    DCR D
60BB C2AF60                JNZ READYCHK
60BE 0D                    DCR C
60BF C2AD60                JNZ NEXTWORD
60C2 C1                    POP B
60C3 C9                    RET
```

FIFOCLR issues the Read Data command to the GDC, thus effecting the FIFO buffer turn-around. You do not have to check whether the FIFO buffer is empty before issuing this command, as any commands and parameters already in the buffer will be dealt with before the Read Data command is actually executed.

```
60C4 3EA0        FIFOCLR:  MVI A,0A0H
60C6 CD0201                CALL OUTC
60C9 C9                    RET
```

Before the Read Data command is issued, you must set up the parameter RAM, and Mask and Figure parameters: bytes 8 and 9 of the parameter RAM and the Mask register must contain FF values to ensure that all bits in the graphic display memory are read; the two significant parameters in FIGSR for the Read Data command are the Direction in the first byte, and the number of words to be read (8, as also specified in READSCRN) in the second byte. The Direction specified is 2 (East), as this enables graphic display memory words to be accessed sequentially without the program overhead of cursor positioning. This means that the first 80 bytes read from the GDC correspond to the top pixel row on the CRT, the next 80 bytes refer to the next pixel row (also reading from left to right), and so on. If you write a program to send screen contents to a printer, you will find it more convenient to set a vertical Direction, thus reading a rectangular area of the screen with each Read Data command.

```
60CA C5        SETREAD:  PUSH B
60CB E5                  PUSH H
60CC 3E78                MVI A,78H
60CE CD0201              CALL OUTC        ;set pRAM
60D1 211822              LXI H,PRAMSR
60D4 0E02                MVI C,2
60D6 CD0E01              CALL OUTP
60D9 3E4A                MVI A,4AH
60DB CD0201              CALL OUTC        ;set mask
60DE 211A22              LXI H,RMASK
60E1 0E02                MVI C,2
60E3 CD0E01              CALL OUTP
60E6 3E4C                MVI A,4CH
60E8 CD0201              CALL OUTC        ;set fig
60EB 211C22              LXI H,FIGSR
60EE 0E0B                MVI C,0BH
60F0 CD0E01              CALL OUTP
60F3 E1                  POP H
60F4 C1                  POP B
60F5 C9                  RET
```

You can now put together these routines to read the lower half of the (monochrome) graphics display memory into the 16,000 byte area SCREEN. This corresponds to the top half of the screen.

```
60F6 21FA01    SAVEIT:   LXI H,CURPRAMS
60F9 3600                MVI M,0          ;reading to start
60FB 23                  INX H            ;at top left
60FC 3600                MVI M,0          ;corner of the
60FE 23                  INX H            ;screen
60FF 3600                MVI M,0
6101 CDFD01              CALL CURSET
6104 212822              LXI H,SCREEN
6107 01E803              LXI B,03E8H
610A CDCA60    NEXTSCRN: CALL SETREAD
610D CDC460              CALL FIFOCLR
6110 CDAA60              CALL READSCRN
6113 0B                  DCX B
6114 3E00                MVI A,0
6116 B8                  CMP B
6117 C20A61              JNZ NEXTSCRN
611A B9                  CMP C
611B C20A61              JNZ NEXTSCRN
611E CDD101              CALL GEXIT
```

Before re-writing your display data to graphics display memory, you might wish to change the data in some way:

```
6121 CD9261              CALL ADJUST
```

Leaving such changes aside for the moment, let us first examine a method of writing the 16,000 byte graphic design, now held in main memory, back into the graphics display memory. You have already practised one way of doing this, namely, in the program example of pixel by pixel drawing under keyboard control. The difference is that the keyboard control is replaced by the permanently set Direction 2 (East). In this way, the screen is built up in the sequence in which it was read. This is accomplished by reading SCREEN byte by byte, shifting each bit of each byte through the Carry flag, and setting the drawing Logic to "set to one" or "reset to zero" in accordance with that CPU flag. The NOP instruction is included to facilitate breakpoint setting when you are testing the program with the debugging utility.

```
6124 218A04    PAINT:    LXI H,FIGPRAM2
6127 110B02              LXI D,FIGPRAMS
612A 0E0B                MVI C,0BH
612C 7E        NEXTPR3:  MOV A,M
612D 12                  STAX D
```

```
612E 23          INX H
612F 13          INX D
6130 0D          DCR C
6131 C22C61      JNZ NEXTPR3
6134 3E02        MVI A,2          ;Direction East
6136 320B02      STA FIGPRAMS
6139 CD4301      CALL GINIT
613C C0FD01      CALL CURSET
613F CD1602      CALL FIGSET
6142 112822      LXI D,SCREEN
6145 01803E      LXI B,3E80H
6148 C5      NEWBYTE:  PUSH B
6149 0E08              MVI C,8
614B 1A                LDAX D
614C 47                MOV B,A
614D CB38    CHECKBIT: DB 0CBH,38H     ;Z-80 SRL B.
614F DA5761            JC PLOT           ;check Carry,
6152 3E22              MVI A,22H         ;set drawing
6154 C35961            JMP LOGICSET      ;Logic
6157 3E23    PLOT:     MVI A,23H         ;accordingly
6159 CD0201  LOGICSET: CALL OUTC
615C 3E4C              MVI A,4CH         ;command to set
615E CD0201            CALL OUTC         ;Figure parameters
6161 210B02            LXI H,FIGPRAMS
6164 C5                PUSH B
6165 0E03              MVI C,3           ;set first three
6167 CD0E01            CALL OUTP         ;Figure parameters
616A C1                POP B
616B 3E6C              MVI A,6CH         ;Draw command
616D CD0201            CALL OUTC
6170 0D                DCR C
6171 C24061            JNZ CHECKBIT
6174 13                INX D
6175 C1                POP B
6176 0B                DCX B
6177 3E00              MVI A,0
6179 B8                CMP B
617A C24861            JNZ NEWBYTE
617D B9                CMP C
617E C24861            JNZ NEWBYTE
6181 3E21              MVI A,21H         ;restore
6183 CD0201            CALL OUTC         ;Complement Logic
6186 CDB601  WAIT6:    CALL GETKEY
6189 FE78              CPI 'x'
```

```
6188 C28661             JNZ WAIT6
618E CD0101             CALL GEXIT
6191 00                 NOP
```

The following routine shows just two of many possibilities of altering the graphic image while it is stored in main memory. You can construct a vector from which one of a number of alteration routines can be activated, according to keyboard input.

```
6192 CD8601   ADJUST:  CALL GETKEY
619C CAA561            JZ ADJUST1      ;pixel inversion
619F FE6D              CPI 'm'
61A1 CABF61            JZ ADJUST2      ;mirror image
619C CAA561            JZ ADJUST1
619F FE6D              CPI 'm'
61A1 CABF61            JZ ADJUST2
61A4 C9                RET
```

The two possibilities envisaged here are the inversion (bit complementing) of the screen image, and the production of a mirror image. The inversion routine simply uses the 8080 instruction to produce the one's complement of a register. The effect is the same as writing all ones with complement Logic into the graphics display memory.

```
61A5 112822   ADJUST1:  LXI D,SCREEN
61A8 01803E             LXI B,3E80H
61AB 1A       ADJUST11: LDAX D
61AC 2F                 CMA
61AD 12                 STAX D
61AE 13                 INX D
61AF 0B                 DCX B
61B0 3E00               MVI A,0
61B2 B8                 CMP B
61B3 C2AB61             JNZ ADJUST11
61B6 B9                 CMP C
61B7 C2AB61             JNZ ADJUST11
61BA C9                 RET
```

The mirror routine (ADJUST2) regards SCREEN as 200 "lines," each containing 80 bytes (= 640 bits for one display line). Each line is turned "back to front." In addition, the same is done within each byte, using the MIRROR routine described earlier. Thus, an arrow which previously pointed left, will now point to

the right when the contents of SCREEN are re-written to graphics display memory.

```
61BB 28          LEFTBYTE: DB 40
61BC 29          RGHTBYTE: DB 41
61BD 2722        LINE:     DW SCREEN -1
                 ;
61BF 01C800      ADJUST2:  LXI B,200
61C2 212722               LXI H,SCREEN -1
61C5 22BD61               SHLD LINE
61C8 C5          NEXTLINE: PUSH B
61C9 3E28                  MVI A,40
61CB 32BB61                STA LEFTBYTE ;starting from center of
61CE 3C                    INR A        ;line working outwards,
61CF 32BC61                STA RGHTBYTE ;exchange byte pairs
61D2 012800                LXI B,40     ;within that line
61D5 C5          LINESWOP: PUSH B
61D6 3ABB61                LDA LEFTBYTE
61D9 5F                    MOV E,A
61DA 1600                  MVI D,0
61DC 2ABD61                LHLD LINE
61DF 19                    DAD D
61E0 7E                    MOV A,M
61E1 CD7021                CALL MIRROR  ;mirror byte within itself.
61E4 47                    MOV B,A      ;left byte of pair in B
61E5 3ABC61                LDA RGHTBYTE
61E8 5F                    MOV E,A
61E9 3C                    INR A
61EA 32BC61                STA RGHTBYTE
61ED 1600                  MVI D,0
61EF 2ABD61                LHLD LINE
61F2 19                    DAD D
61F3 7E                    MOV A,M
61F4 CD7021                CALL MIRROR  ;mirror byte within itself.
61F7 4F                    MOV C,A      ;right byte of pair in C.
61F8 70                    MOV M,B      ;new right byte taken from B
61F9 2ABD61                LHLD LINE
61FC 3ABB61                LDA LEFTBYTE
61FF 5F                    MOV E,A
6200 3D                    DCR A
6201 32BB61                STA LEFTBYTE
6204 1600                  MVI D,0
6206 19                    DAD D
6207 71                    MOV M,C      ;new left byte taken from C
```

```
6208 C1                 POP B
6209 3E00               MVI A,0
620B 0B                 DCX B
620C B8                 CMP B
620D C2D561             JNZ LINESWOP
6210 B9                 CMP C
6211 C2D561             JNZ LINESWOP
6214 2AB061             LHLD LINE
6217 115000             LXI D,80
621A 19                 DAD D           ;point to next
621B 22B061             SHLD LINE       ;line of screen
621E C1                 POP B
621F 0B                 DCX B
6220 B8                 CMP B
6221 C2C861             JNZ NEXTLINE
6224 B9                 CMP C
6225 C2C861             JNZ NEXTLINE
6228 C9                 RET
```

You are probably asking yourself why the screen writing takes so much time. There are two factors to be considered. First, the program described above does a complete write operation, in the sense that each pixel is addressed, irrespective of whether it is to be turned on or not. The fast method of drawing a figure on the screen is to store and output the coordinates and other parameters which relate solely to the pixels to be plotted, and to make use of the GDC's figure drawing capabilities (line, arc, etc.). This is how the square and circle were drawn in the earlier examples. In fact, you can draw many more figures, and the drawing process will still appear to be instantaneous. The second factor regarding the speed of the screen write is that the Figure parameters have to be restored for each pixel.

There are two other methods of screen writing in the graphics mode, both of which give improved performance. One method is to load the parameter RAM with one 8 x 8 pixel pattern after another. This creates some additional program overhead for cursor positioning. For this reason, the following method is worth considering:

```
6229 CD9261             CALL ADJUST
622C CD4301             CALL GINIT
622F 3E4C               MVI A,4CH       ;command to set
6231 CD0201             CALL OUTC       ;Figure parameters
6234 212722             LXI H,MASKFIG
```

```
6237 0E01              MVI C,1         ;only one required
6239 CD0E01            CALL OUTP
623C CDFD01            CALL CURSET
623F 212822            LXI H,SCREEN
6242 11A860            LXI D,DUMBYTES
6245 01401F            LXI B,1F40H
6248 C5       NEXTMASK: PUSH B
6249 3E4A              MVI A,4AH       ;command to
624B CD0201            CALL OUTC       ;load Mask
624E 0E02              MVI C,2         ;with word of
6250 CD0E01            CALL OUTP       ;screen contents.
6253 3E23              MVI A,23H       ;write to screen
6255 CD0201            CALL OUTC       ;with "set" Logic...
6258 EB                XCHG            ;(HL now points to
                                       ; DUMBYTES)
6259 0E02              MVI C,2         ;... setting all bits
625B CD0E01            CALL OUTP       ;that are set in Mask
625E 2B                DCX H
625F 2B                DCX H
6260 EB                XCHG            ;HL now points to
                                       ;next screen word,
                                       ;DE to DUMBYTES
6261 C1                POP B
6262 0B                DCX B
6263 3E00              MVI A,0
6265 B8                CMP B
6266 C24862            JNZ NEXTMASK
6269 B9                CMP C
626A C24862            JNZ NEXTMASK
626D CDB601   WAIT7:   CALL GETKEY
6270 FE78              CPI 'x'
6272 C26D62            JNZ WAIT7
6275 CD0101            CALL GEXIT
6278 00                NOP
```

As before, the writing Direction should be set to 2 (East), thus enabling sequential writing without the need to position the cursor, beyond initially specifying the top left corner (check CURPRAMS). This program loads the Mask register word by word with the contents of SCREEN. The Write Data command is transmitted to the GDC with all its parameter bits set. This means that the 16-bit pattern contained in the Mask register appears as a horizontal pattern of data on the screen in one write cycle. There is no need to repeat the Figure parameter setting. By altering the

initial cursor position, you can address different parts of the screen.

COLOR GRAPHICS

The discussion of the GDC and the programming examples so far have dealt with graphics on a monochrome CRT. If your NCR DECISION MATE V has a color CRT, you can make full use of color in the graphics as well as the non-graphics mode. For this purpose, the graphic display RAM has a capacity of 96 KB, instead of the 32 KB RAM used by monochrome CRTs. Even the larger RAM area lies well within the addressing capability of the GDC.

Whereas color in the non-graphic mode is stored in the video attribute byte belonging to each 16 x 8 character area of the graphic display RAM, the graphic mode requires the use of three separate areas corresponding to the green, red, and blue guns of the color CRT. Therefore, your graphics programs must influence not just one, but three bit maps, if you wish to make full use of the color range. The bit maps start at 32 KB boundaries in the 96 KB graphic display memory. Even if you wish to confine pixel writing and drawing to green on black (the first 32 KB govern the green gun, the next 32 KB the red gun, and the last 32 KB the blue gun), you must adapt your graphics initialization routine to reset bits in all three maps. This ensures that the screen is black. Failure to do so may produce intermittent splashes of red and blue.

Apart from this, all you have to remember is that each Draw and Draw Graphics Character command must be repeated once or twice, or not at all, according to the color effect desired.

APPENDIX B

CP/M-80 BIOS PROGRAM

```
                        003    (MBIOS)

66
67                      ;*****************************************************************
68                      ;*                                                               *
69                      ;* module name = ncrbios.asm                                     *
70                      ;*                                                               *
71                      ;*****************************************************************
72  DE00 =              STBIOS  EQU     0DE00H          ;START OF BIOS
73  DE0C =              NCONOUT EQU     STBIOS+12       ;OUTPUT A CHARACTER TO CRT
74                      PAGE


                        004    (MBIOS)

75
76                      VERSEQU
77      +               ;*****************************************************************
78      +               ;*                                                               *
79      +               ;*                      SWITCHES 07.0o.83   10:00 PM             *
80      +               ;*                                                               *
81      +               ;*****************************************************************
82      +
83  0000+=              CPMRAM  EQU     0               ; CP/M RAM BASE
84  0002+=              CPMVER  EQU     2               ; CP/M VERSION
85  0000+=              RELEASEH        EQU     0       ; NCR RELEASE HIGH BYTE
86  0004+=              RELEASE EQU     4               ; NCR RELEASE LOW BYTE
87  0000+=              NCRVERH EQU     2               ; NCR VERSION HIGH BYTE
88  0004+=              NCRVER  EQU     4               ; NCR VERSION LOW BYTE
89  0001+=              DNBRR   EQU     1               ; D-NUMBER RELEASE
90  0000+=              DNBRS   EQU     0               ; D-NUMBER SUBISSUE
91  0FF7+=              FWVER   EQU     0FF7H           ; LOCATION OF FWVERSION IN FIRMWARE
92      +                       PAGE
```

```
                005     ;MBIOS)

 93       +
 94       +              ENDM
 95                  STADDEQU
 96       +          ;*****************************************************
 97       +          ;*                                                   *
 98       +          ;*      START ADDRESS EQUATES   27/10/82 10:21 WF    *
 99       +          ;*                                                   *
100       +          ;*****************************************************
101       +
102       +
103  DEC0+=          BIOS    EQU     0DEC0H          ; START ADDRESS OF BIOS
104       +
105  CC00+=          BDOSSZ  EQU     0E00H           ;
106       +
107       +
108  0800+=          CCPSZ   EQU     0800H           ; CCP SIZE
109       +
110  D000+=          BDOS    EQU     BIOS-BDOSSZ     ; START OF BDOS
111  C800+=          CCP     EQU     BDOS-CCPSZ      ; START OF CCP
112       +
113       +
114  D006+=          BDOSNTRY        EQU     BDOS+6
115  D047+=          BDOSTBL EQU     BDOS+47H        ; BDOS FUNCTION TABLE START ADDRESS
116  C803+=          CCPSTB  EQU     CCP+3
117       +
118       +
119       +                  PAGE
```

```
                        006     (MBIOS)

120       +
121       +                     ENDM
122                     DISKCEQU
123       +             ;*****************************************************************
124       +             ;*                                                               *
125       +             ;*              DISK CONTROLLER EQUATES 30.11.82 11:56 PH        *
126       +             ;*                                                               *
127       +             ;*****************************************************************
128       +
129       +
130   0051+=            DCOMD   EQU     00051H          ; DISK COMMAND PORT
131   0050+=            DSTAT   EQU     00050H          ; DISK STATUS PORT
132   0051+=            FDCRA   EQU     00051H          ; READ DATA FROM FDC
133       +             ;
134   0001+=            MOTOROFF        EQU     01H     ; MOTOR OFF INDICATOR (SYSSTA)
135       +             ;
136       +             ;
137   0010+=            RAMSEL  EQU     00010H          ; RAM SELECT
138   0011+=            ROMSEL  EQU     00011H          ; ROM SELECT
139   0012+=            SETTC   EQU     00012H          ; SET TC
140   0013+=            SYSSTA  EQU     00013H          ; SYSTEM STATUS PORT
141   0014+=            MOTORON EQU     00014H          ; MOTOR ON
142   0026+=            COAD    EQU     00026H          ; FDC DMA CHANNEL
143   0027+=            COTC    EQU     00027H          ; FDC DMA CHANNEL
144   0028+=            DMACOM  EQU     00028H          ; DMA COMMAND
145   0028+=            DMAST   EQU     00028H          ; READ DMA STATUS
146   0028+=            DMAMO   EQU     0002BH
147   002A+=            DMAMB   EQU     0002AH
148       +
149   0004+=            DMAWRT  EQU     004H            ; DMA WRITE COMMAND
150   0008+=            DMAREAD EQU     008H            ; DMA READ COMMAND
151       +
152   0003+=            ENFD    EQU     003H            ; ENABLE FDC CHANNEL (CH3)
153   0007+=            DISFD   EQU     007H            ; DISABLE FDC CHANNEL (CH3)
154       +
155       +
156       +                     PAGE
```

```
157     +
158     +           ENDM
159                 CNTLEQU
160     +           ;*****************************************************************
161     +           ;*                                                               *
162     +           ;*      CONTROL CHARACTER EQUATES 27/10/82 10:22 WF              *
163     +           ;*                                                               *
164     +           ;*****************************************************************
165     +
166     +
167     0003+=      IOBYTE  EQU     3       ; I/O BYTE
168     0004+=      CURDISK EQU     4       ; CURRENT DISK NUMBER
169     000D+=      CR      EQU     0DH     ; CARRIGE RETURN
170     000A+=      LF      EQU     0AH     ; LINE FEED
171     0008+=      BS      EQU     08H     ; BACK SPACE
172     000C+=      FF      EQU     0CH     ; FORM FEED
173     000C+=      TOF     EQU     0CH     ; TOP OF FORM
174     001B+=      ESC     EQU     1BH     ; ESCAPE
175     001A+=      CLRSCN  EQU     01AH    ; CLEAR SCREEN
176     +                   PAGE
```



```
177     +           ENDM
178     +           PAGE
179
```

```
                        009     (MBIOS)

180
181                     ;
182                     ;
183   0000 C32100       BEGIN:  JMP     BMOVE           ; JUMP TO MOVE ROUTINE
184   0003 4350402032           DB      'CPM 2.2'       ; DISK IDENTIFICATION
185   000A 4E43522046           DB      'NCR F3'        ; DISK FORMAT 0005
186   0010 323034               DB      CPMVER+'0',RELEASEH+'0',RELEASE+'0'
187   0013 3034                 DB      NCRVERH+'0',NCRVER+'0'  ; INTERNAL RELEASE NUMBER
188   0015 30303030305NR:       DB      '0','0','0','0','0'    ; SERIAL NUBMER
189   001A 2863292043           DB      '(c) NCR'       ; COPYRIGHT
190                     ;
191   0021 310070       BMOVE:  LXI     SP,7000H        ; TEMPORARILY STACK
192   0024 21000E               LXI     H,BIOS          ; BIOS START ADDRESS
193   0027 110022               LXI     D,2200H         ; START OF BIOS IN MEMORY
194   002A 010018               LXI     B,1800H         ; LENGTH OF BIOS
195   002D CDC600               CALL    MOVER           ; MOVE BIOS TO THE RIGHT ADDRESS
196                     ;
197                     ;
198                     ;       DISPLAY FIRMWARE VERSION
199                     ;
200                     ;
201   0030 21F70F               LXI     H,FWVER
202   0033 7E                   MOV     A,M
203   0034 FE08                 CPI     08H
204   0036 C24A00               JNZ     RAMTEST         ; JUMP IF OLD FIRMWARE
205   0039 3E46         FW1:    MVI     A,'F'
206   003B 324501               STA     FWMESS1         ; ACTIVATE FWVERSION DISPLAY
207   003E 11F80F               LXI     D,FWVER+1
208   0041 215701               LXI     H,FWMESS2
209   0044 010800               LXI     B,8
210   0047 CDC600               CALL    MOVER           ; MOVE FIRMWARE VERSION
211
212
213
214                     PAGE
```

```
                        010    (MBIOS)

215
216                     ;
217                     ;
218                     ; RAMTEST
219                     ;
220                     ;
221                     RAMTEST:
222   004A D310                 OUT     RAMSEL          ; SWITCH TO LOW RAM (0-FFFH)
223                     RTEST1:
224   004C 210000               LXI     H,0
225                     RTEST2:
226   004F 3655                 MVI     M,055H
227   0051 23                   INX     H
228   0052 36AA                 MVI     M,0AAH
229   0054 23                   INX     H
230   0055 7C                   MOV     A,H
231   0056 FE20                 CPI     20H
232   0058 C24F00               JNZ     RTEST2          ; FILL MEMORY WITH 55AA55AA
233   005B 2B         RTEST3:   DCX     H
234   005C 7C                   MOV     A,H
235   0050 FEFF                 CPI     0FFH
236   005F CA7200               JZ      RTEST4          ; JUMP IF TEST OK
237   0062 7E                   MOV     A,M
238   0063 FEAA                 CPI     0AAH
239   0065 C29300               JNZ     RERROR          ; RAM - TEST ERROR
240   0068 2B                   DCX     H
241   0069 7E                   MOV     A,M
242   006A FE55                 CPI     055H
243   006C CA5B00               JZ      RTEST3          ; GET NEXT BYTE
244   006F C39300               JMP     RERROR          ; RAM - TEST ERROR
245   0072 23         RTEST4:   INX     H
246   0073 36AA       RTEST5:   MVI     M,0AAH
247   0075 23                   INX     H
248   0076 3655                 MVI     M,055H
249   0078 23                   INX     H
250   0079 7C                   MOV     A,H
251   007A FE20                 CPI     20H
252   007C C27300               JNZ     RTEST5          ; FILL MEMORY WITH AA55AA55
253   007F 2B         RTEST6:   DCX     H
254   0080 7C                   MOV     A,H
255   0081 FEFF                 CPI     0FFH
256   0083 CA6201               JZ      SIGNON          ; JUMP TO COLD BOOT ROUTINE
257   0086 7E                   MOV     A,M
258   0087 FE55                 CPI     055H
259   0089 C29300               JNZ     RERROR          ; RAM - TEST ERROR
260   008C 2B                   DCX     H
261   008D 7E                   MOV     A,M
262   008E FEAA                 CPI     0AAH
263   0090 CA7F00               JZ      RTEST6          ; GET NEXT BYTE
264   0093 219A00     RERROR:   LXI     H,RAMERROR
265   0096 CD7701               CALL    DISPERR         ; DISPLAY ERROR MESSAGE
266   0099 76                   HLT                     ; NO MORE RESPONSE
267                     ;
268                     ;
269                     RAMERROR:
270   009A 1A                   DB      CLRSCN
```

```
                        011     (MBIOS)

271   0098 18303820             DB      ESC,'=',24+20H,0+20H    ;SET CURSOR TO ERROR LINE
272   009F 4552524F52           DB      'ERROR ENCOUNTERED AT RAM TEST (0-1FFF)'
273   00C5 24                   DB      '$'
274
275
276
277                             PAGE



                        012     (MBIOS)

278
279                     ;
280                     ;       MOVE BC-BYTES FROM A(DE) -) A(HL)
281                     ;
282                     ;
283                     ;
284                     MOVER:
285   00C6 1A                   LDAX    D
286   00C7 77                   MOV     M,A
287   00C8 23                   INX     H
288   00C9 13                   INX     D
289   00CA 0B                   DCX     B
290   00CB 78                   MOV     A,B
291   00CC B1                   ORA     C
292   00CD C8                   RZ                      ; RETURN IF ALL MOVED
293   00CE C3C600               JMP     MOVER
294                             PAGE
```

```
                ;*****************************************
                ;*                                       *
                ;*   DISPLAY SIGNON MESSAGE              *
                ;*                                       *
                ;*****************************************
                ;
                ;
                ;
                ;
                ;
                SIGNMSG:
0001 1A                 DB      CLRSCN
0002 0D0A               DB      CR,LF
0004 43502F4D20         DB      'CP/M (R) 2.2 for NCR DECISION MATE V'
00F8 0D0A               DB      CR,LF
00FA 4430303620         DB      'D006-0051-',DMBRR+'0',DMBRS+'0','0C'
0108 0D0A               DB      CR,LF
010A 436F707972          DB      'Copyright (c) 1982, DIGITAL RESEARCH'
012E 0D0A               DB      CR,LF
0130 5365726961         DB      'Serial Number '
013E            SIGNMSG1:       DS      5                       ; SERIAL NUMBER
0143 0D0A               DB      CR,LF
0145 2469726077FWMESS1:DB       '$irmware Version: '
0157 2020202020FWMESS2:         DB      '       '
015F 0D0A24             DB      CR,LF,'$'

                SIGNON:
0162 111500             LXI     D,SMR
0165 213E01             LXI     H,SIGNMSG1
0168 010500             LXI     B,5
016B CDC600             CALL    MOVER           ; MOVE SERIAL NUMBER
016E 21D100             LXI     H,SIGNMSG
0171 CD7701             CALL    DISPERR         ; DISPLAY MESSAGE
0174 C3000E             JMP     STBIOS          ; JUMP TO COLD BOOT ROUTINE

                        PAGE
```



```
                DISPERR:
0177 3E01               MVI     A,01
0179 320300             STA     IOBYTE          ; SET TEMPORARY I/O BYTE FOR CRT
                DISP1:
017C 7E                 MOV     A,M
017D FE24               CPI     '$'
017F C8                 RZ
0180 4F                 MOV     C,A
0181 E5                 PUSH    H
0182 CD0CDE             CALL    MCONOUT         ;DISPLAY CHARACTER
0185 E1                 POP     H
0186 23                 INX     H
0187 C37C01             JMP     DISP1           ;NEXT CHARACTER
018A            END
```

015 (MBIOS)

BDOS	D000	110‡	111	114	115		
BDOSNTRY	D006	114‡					
BDOSSZ	0E00	105‡	110				
BDOSTBL	D047	115‡					
BEGIN	0000	183‡					
BIOS	DE00	103‡	110	192			
BMOVE	0021	183	191‡				
BS	0009	171‡					
CCP	C800	111‡	116				
CCPSTB	C803	116‡					
CCPSZ	0800	108‡	111				
CLRSCH	001A	175‡	270	307			
COAD	0026	142‡					
COTC	0027	143‡					
CPMRAM	0000	83‡					
CPMVER	0002	84‡	186				
CR	000D	169‡	308	310 - 312	314	317	320
CURDISK	0004	168‡					
DCOMD	0051	130‡					
DISFD	0007	153‡					
DISP1	017C	336‡	345				
DISPERR	0177	265	328	333‡			
DMACOM	0028	144‡					
DMAMB	002A	147‡					
DMAMO	0028	146‡					
DMAREAD	0008	150‡					
DMAST	0028	145‡					
DMAWRT	0004	149‡					
DMBRR	0001	89‡	311				
DMBRS	0000	90‡	311				
DSTAT	0050	131‡					
EMFD	0003	152‡					
ESC	001B	174‡	271				
FDCRA	0051	132‡					
FF	000C	172‡					
FW1	0039	205‡					
FWMESS1	0145	206	318‡				
FWMESS2	0157	208	319‡				
FWVER	0FF7	91‡	201	207			
IOBYTE	0003	167‡	335				
LF	000A	170‡	308	310	312	314	317	320
MOTOROFF	0001	134‡					
MOTORON	0014	141‡					
MOVER	00C6	195	210	284‡	293	326	
MCONOUT	DE0C	73‡	342				
MCRVER	0004	88‡	187				
MCRVERH	0000	87‡	187				
RAMERROR	009A	264	269‡				
RAMSEL	0010	137‡	222				
RAMTEST	004A	204	221‡				
RELEASE	0004	86‡	186				
RELEASEH	0000	85‡	186				
RERROR	0093	239	244	259	264‡		
ROMSEL	0011	138‡					
RTEST1	004C	223‡					
RTEST2	004F	225‡	232				

```
RTEST3          0058   233↕  243
RTEST4          0072   236   245↕
RTEST5          0073   246↕  252
RTEST6          007F   253↕  263
SETTC           0012   139↕
SIGNMSG         0001   306↕  327
SIGNMSG1        013E   316↕  324
SIGNON          0162   256   322↕
SMR             0015   188↕  323
STBIOS          DE00    72↕   73   329
SYSSTA          0013   140↕
TOF             000C   173↕
(
```

```
                003    (NBIOS)

66
67              ;*****************************************************************
68              ;*****************************************************************
69              ;********                                               ********
70              ;********       EXTERNAL DEFINITIONS                    ********
71              ;********                                               ********
72              ;*****************************************************************
73              ;*****************************************************************
74              ;
75              ;
76              ;
77              EXTRN   CONST,CONIN,LIST,PUNCH,READER,LISTST,WRCUPO
78              EXTRN   RESET,CINIT,WINIT,DSKSET,READSEC1,DSKERR,CHECKOS
79              EXTRN   TRKSET,SECSET,DMASET,BTRECS,CREAD,PMAADR,RDTRAK
80              EXTRN   CURCOL,CLRLI1,CONOUT,FORMATT,CWRITE,DHOME
81              EXTRN   SEKDSK,SEKTRK,SEKSEC,DMAADR,READOP,WRTYPE,SEKHST
82              EXTRN   UNACNT,UNADSK,UNATRK,UNASEC,READID,DSKCMD
83              EXTRN   RSFLAG,HSTACT,HSTDSK,HSTTRK,HSTSEC,HSTWRT
84              EXTRN   DISKIO,ERFLAG,DTRKSET,SAVESEC
85              EXTRN   FREAD,FWRITE
86
87
88              PAGE



                004    (NBIOS)

89
90              ;*****************************************************************
91              ;*****************************************************************
92              ;********                                               ********
93              ;********            ENTRY DEFINITIONS                  ********
94              ;********                                               ********
95              ;*****************************************************************
96              ;*****************************************************************
97              ;
98              ;
99              ;
100             PUBLIC  CRTTBL,OFST,CONFIGFL,KEYTBL,FUNTBL,MOVE,FNTBLMD
101             PUBLIC  COMPDEHL,MOVEL,FMERRM,DISPERR,MULT,SUBHLDE
102             PUBLIC  RSTC,RETRYC,IOBSET,STBIOS,CMPRE,DSKTYP,MRDYRX
103             PUBLIC  CLOSE,MOTRDYM,WRPRCTM,FATERRM,IOERRM,DISPERR
104             PUBLIC  WBOTE,M1RS232,M2RS232,PVRS232,DSKGET,FIXINIT
105             PUBLIC  DSKMSC,DSKSLC,DSKSID,DSKTRK,FLUSH,CLRLIN,MBRFLEX
106
107                     PAGE
```

```
                        005    (NBIOS)

108
109                     VERSEQU
110   0000+=            CPMRAM  EQU     0               ; CP/M RAM BASE
111   0002+=            CPMVER  EQU     2               ; CP/M VERSION
112   0000+=            RELEASEH        EQU     0       ; NCR RELEASE HIGH BYTE
113   0004+=            RELEASE EQU     4               ; NCR RELEASE LOW BYTE
114   0000+=            NCRVERH EQU     0               ; NCR VERSION HIGH BYTE
115   0004+=            NCRVER  EQU     4               ; NCR VERSION LOW BYTE
116   0001+=            DNBRR   EQU     1               ; D-NUMBER RELEASE
117   0000+=            DNBRS   EQU     0               ; D-NUMBER SUBISSUE
118   0FF7+=            FWVER   EQU     0FF7H           ; LOCATION OF FWVERSION IN FIRMWARE
```

```
                        006    (NBIOS)

119                     STADDEQU
120   0E00+=            BIOS    EQU     0DE00H          ; START ADDRESS OF BIOS
121   0E00+=            BDOSSZ  EQU     0E00H           ;
122   0800+=            CCPSZ   EQU     0800H           ; CCP SIZE
123   D000+=            BDOS    EQU     BIOS-BDOSSZ     ; START OF BDOS
124   C800+=            CCP     EQU     BDOS-CCPSZ      ; START OF CCP
125   D006+=            BDOSNTRY        EQU     BDOS+6
126   D047+=            BDOSTBL EQU     BDOS+47H        ; BDOS FUNCTION TABLE START ADDRESS
127   C803+=            CCPSTB  EQU     CCP+3
```

```
                        007    (NBIOS)

128                     DISKCEQU
129     0051+=          DCOMD   EQU     00051H          ; DISK COMMAND PORT
130     0050+=          DSTAT   EQU     00050H          ; DISK STATUS PORT
131     0051+=          FDCRA   EQU     00051H          ; READ DATA FROM FDC
132     0001+=          MOTOROFF        EQU     01H     ; MOTOR OFF INDICATOR (SYSSTA)
133     0010+=          RAMSEL  EQU     (               ; RAM SELECT
134     0011+=          ROMSEL  EQU     (               ; ROM SELECT
135     0012+=          SETTC   EQU     (               ; SET TC
136     0013+=          SYSSTA  EQU     (               ; SYSTEM STATUS PORT
137     0014+=          MOTORON EQU     (               ; MOTOR ON
138     0026+=          COAD    EQU     (               ; FDC DMA CHANNEL
139     0027+=          COTC    EQU     (               ; FDC DMA CHANNEL
140     0028+=          DMACOM  EQU     (               ; DMA COMMAND
141     0028+=          DMAST   EQU     (               ; READ DMA STATUS
142     002B+=          DMAMO   EQU     (
143     002A+=          DMAMB   EQU     (
144     0004+=          DMAWRT  EQU     (               ; DMA WRITE COMMAND
145     0008+=          DMAREAD EQU     (               ; DMA READ COMMAND
146     0003+=          ENFD    EQU     (               ; ENABLE FDC CHANNEL (CH3)
147     0007+=          DISFD   EQU     (               ; DISABLE FDC CHANNEL (CH3)



                        008    (NBIOS)

148                     CNTLEQU
149     0003+=          IOBYTE  EQU     3               ; I/O BYTE
150     0004+=          CURDISK EQU     4               ; CURRENT DISK NUMBER
151     000D+=          CR      EQU     0DH             ; CARRIGE RETURN
152     000A+=          LF      EQU     0AH             ; LINE FEED
153     0008+=          BS      EQU     08H             ; BACK SPACE
154     000C+=          FF      EQU     0CH             ; FORM FEED
155     000C+=          TOF     EQU     0CH             ; TOP OF FORM
156     001B+=          ESC     EQU     1BH             ; ESCAPE
157     001A+=          CLRSCN  EQU     01AH            ; CLEAR SCREEN
```

```
                        009     (NBIOS)

158                     KEYEQU
159     0040+=          KEYBASE EQU     0040H           ; BASE ADDRESS OF KEYBOARD
160     0040+=          WDKEY   EQU     KEYBASE         ; WRITE DATA TO KEYBOARD
161     0040+=          RDKEY   EQU     KEYBASE         ; READ DATA FROM KEYBOARD
162     0041+=          RSKEY   EQU     KEYBASE+1       ; READ KEYBOARD STATUS
163     0041+=          KBELL   EQU     KEYBASE+1       ; RING BELL
164     0041+=          KCOUNT  EQU     KEYBASE+1       ; COUNTRY CODE PORT
165     0002+=          INPBFF  EQU     02H             ; INPUTBUFFER FULL
166     0001+=          OUTPBFF EQU     01H             ; OUTPUTBUFFER FULL
167     0080+=          LGDAT   EQU     80H             ; LANGUAGE CODE READY FLAG
168     0001+=          KBDAT   EQU     01H             ; DATA READY BIT
169     0001+=          COUNTRY EQU     01H             ; COMMAND TO GET COUNTRY CODE
170     0006+=          MUSICC  EQU     C6H             ; MUSIC COMMAND
171                     DISKBFF
172     F600+=          HSTBUF  EQU     0F600H          ;LENGTH 400H
173     FA00+=          DIRBUF  EQU     HSTBUF+400H     ;LENGTH 128
174     FA80+=          ALV0    EQU     DIRBUF+128      ;LENGTH 32
175     FAA0+=          CSV0    EQU     ALV0+32         ;LENGTH 64
176     FAE0+=          ALV1    EQU     CSV0+64         ;LENGTH 81
177     FB31+=          CSV1    EQU     ALV1+81         ;LENGTH 64
178     FB71+=          ALV2    EQU     CSV1+64         ;LENGTH 81
179     0000+=          CSV2    EQU     0               ;NOT USED FOR HARD DISK
180     FBC2+=          ALV3    EQU     ALV2+81         ;LENGTH 81
181     0000+=          CSV3    EQU     0               ;NOT USED FOR HARD DISK
182     FC13+=          ALV4    EQU     ALV3+81         ;LENGTH 81
183     0000+=          CSV4    EQU     0               ;NOT USED FOR HARD DISK
184     FC64+=          ALV5    EQU     ALV4+81         ;LENGTH 81
185     0000+=          CSV5    EQU     0               ;NOT USED FOR HARD DISK
186     FCB5+=          ALV6    EQU     ALV5+81         ;LENGTH 81
187     0000+=          CSV6    EQU     0               ;NOT USED FOR HARD DISK
188     FD06+=          ALV7    EQU     ALV6+81         ;LENGTH 81
189     0000+=          CSV7    EQU     0               ;NOT USED FOR HARD DISK
190     FD57+=          ALV8    EQU     ALV7+81         ;LENGTH 81
191     0000+=          CSV8    EQU     0               ;NOT USED FOR HARD DISK
192     FDA8+=          ALV9    EQU     ALV8+81         ;LENGTH 81
193     0000+=          CSV9    EQU     0               ;NOT USED FOR HARD DISK
194     FDF9+=          LINBUF  EQU     ALV9+81         ;LENGTH 160
195     FE99+=          DPB0    EQU     LINBUF+160      ;LENGTH 15
196     FEA8+=          DPB1    EQU     DPB0+15         ;LENGTH 15
197     FEB7+=          DPB2    EQU     DPB1+15         ;LENGTH 15
198     FEC6+=          DPB3    EQU     DPB2+15         ;LENGTH 15
199     FED5+=          DPB4    EQU     DPB3+15         ;LENGTH 15
200     FEE4+=          DPB5    EQU     DPB4+15         ;LENGTH 15
201     FEF3+=          DPB6    EQU     DPB5+15         ;LENGTH 15
202     FF02+=          DPB7    EQU     DPB6+15         ;LENGTH 15
203     FF11+=          DPB8    EQU     DPB7+15         ;LENGTH 15
204     FF20+=          DPB9    EQU     DPB8+15         ;LENGTH 15
205                             PAGE
```

```
                    010    (NBIOS)

206
207                 ;*****************************************************************
208                 ;*                                                               *
209                 ;*              BIOS BEGINS HERE                                 *
210                 ;*                                                               *
211                 ;*****************************************************************
212
213
214
215   0000 C35B00   STBIOS: JMP     CBOOT     ; COLD BOOT      3E5B
216   0003 C36F00   WBOTE:  JMP     WBOOT     ; WARM BOOT      3E6F
217   0006 C30000           JMP     CONST     ; GET CONSOLE STATUS  EC21
218   0009 C30000           JMP     CONIN     ; GET CONSOLE CHARACTER EC2F
219   000C C30000           JMP     CONOUT    ; OUTPUT A CHARACTER TO CRT  EC3D
220   000F C30000           JMP     LIST      ; OUTPUT TO LIST DEVICE      EC6D
221   0012 C30000           JMP     PUNCH     ; OUTPUT TO PUNCH DEVICE     EC4B
222   0015 C30000           JMP     READER    ; GET CHARACTER FROM READER
223   0018 C3A001           JMP     HOME      ; HOME DISK (SET TRACK TO 0)
224   001B C35B01           JMP     SELDSK    ; SELECT DISK
225   001E C3AB01           JMP     SETTRK    ; SET TRACK
226   0021 C38101           JMP     SETSEC    ; SET SECTOR
227   0024 C38701           JMP     SETDMA    ; SET DMA ADDRESS
228   0027 C3A405           JMP     READ      ; READ SECTOR
229   002A C38805           JMP     WRITE     ; WRITE SECTOR
230   002D C30000           JMP     LISTST    ; GET STATUS OF THE LIST DEVICE
231   0030 C38D01           JMP     SECTRAN   ; TRANSLATE SECTOR NUMBER
232   0033 C33401           JMP     SPECFUN   ; EXECUTE SPECIAL BIOS FUNCTIONS
233   0036 C35108           JMP     SELTYP    ; RETURN PARAMETERS FOR TYPSELECTION
234                 DISPERR:
235   0039 C33B08           JMP     DISPER0    ; DISPLAY ERROR MESSAGE
236                 CLRLIN:
237   003C C30000           JMP     CLRLI1     ; CLEAR ERROR LINE
238                         PAGE
```

```
                ;*****************************************************************
                ;*                                                               *
                ;*      INITIALIZE BDOS                                          *
                ;*                                                               *
                ;*****************************************************************

                INITBDOS:
003F 21610D             LXI     H,BDOSTBL+13*2  ; HL - A(BDOS FUNCTION 13 TABLE ENTRY)
0042 E5                 PUSH    H               ; SAVE PARAMETER
0043 5E                 MOV     E,M             ; ACTUAL ADDR --) HL
0044 23                 INX     H
0045 56                 MOV     D,M
0046 EB                 XCHG                    ;
0047 225900             SHLD    BDOSRA          ; STORE RESTART ADDRESS
004A 115200             LXI     D,RSTBDOS       ;
004D E1                 POP     H
004E 73                 MOV     M,E
004F 23                 INX     H
0050 72                 MOV     M,D
0051 C9                 RET


                ;*****************************************************************
                ;*                                                               *
                ;*      BDOS RESET FUNCTION                                      *
                ;*                                                               *
                ;*****************************************************************

                RSTBDOS:
0052 CD0000             CALL    RESET           ; WARM RESET
0055 2A5900             LHLD    BDOSRA          ; GET BDOS RESET FUNCTION ADDR
0058 E9                 PCHL                    ;    EXECUTE

0059 0000       BDOSRA: DW      00              ; BDOS RESET FUNCTION ADDR

                        PAGE
```

```
                    012    (NBIOS)

276
277                 ;*****************************************************************
278                 ;*                                                               *
279                 ;*      CBOOT   COLD BOOT                                        *
280                 ;*                                                               *
281                 ;*****************************************************************
282
283
284                 CBOOT:
285   0058 F3               DI
286   005C 310001           LXI     SP,100H
287   005F CD0000           CALL    CINIT           ; COLD INIT
288   0062 CD0000           CALL    RESET           ; RESET DISKS
289   0065 CDA900           CALL    LOADSYS         ; LOAD CCP AND BDOS
290   0068 AF               XRA     A
291   0069 320400           STA     CURDISK         ; SET DRIVE A = CURRENT DRIVE
292   006C C37D00           JMP     NCRDMV
293
294
295
296                 ;*****************************************************************
297                 ;*                                                               *
298                 ;*      WBOOT   WARM BOOT                                        *
299                 ;*                                                               *
300                 ;*****************************************************************
301
302
303                 WBOOT:
304   006F 310001           LXI     SP,100H
305   0072 CD0000           CALL    RESET           ; RESET DISKS
306   0075 CDA900           CALL    LOADSYS         ; LOAD CCP AND BDOS
307   0078 CD0000           CALL    WINIT           ; WARM INIT
308   007B 3EFF             MVI     A,0FFH          ; SET FLAG FOR WARM BOOT
309                 PAGE
```

```
                ;*****************************************************************
                ;*                                                               *
                ;*      NCRDMV  INIT PAGE ZERO                                   *
                ;*                                                               *
                ;*****************************************************************


                NCRDMV:
0070 B7                 ORA     A
007E F5                 PUSH    PSW             ; IF COLD START THEN Z = ON
007F CD3F00             CALL    INITBDOS        ; INITIALIZE BDOS RESET FUNCTION

0082 3EC3               MVI     A,0C3H          ; 'JMP' INSTRUCTION
0084 320000             STA     CPMRAM          ; WBOOT 'JMP'
0087 320500             STA     CPMRAM+5        ; BDOS 'JMP'
008A 21D3DE             LXI     H,BIOS+3
008D 220100             SHLD    CPMRAM+1        ; INIT WARM BOOT 'JMP' ADDRESS
0090 2106D0             LXI     H,BDOSNTRY
0093 220600             SHLD    CPMRAM+6        ; INIT BDOS 'JMP' ADDRESS
0096 3A0400             LDA     CURDISK
0099 4F                 MOV     C,A             ; USER # = X, DISK UNIT = Y ,XXXXYYYY
009A F1                 POP     PSW             ; RESTORE FLAGS
009B 3A0E02             LDA     MODEFL          ; GET MODE FLAG
009E 0F                 RRC
009F CAA300             JZ      G01             ; JUMP IF COLD BOOT
00A2 0F                 RRC
00A3 D203C8     G01:    JNC     CCPSTB          ; JUMP IF NO AUTO LOAD
00A6 C300C8             JMP     CCP             ; JUMP IF AUTO LOAD

                PAGE
```

```
                        015    (NBIOS)

397
398                     ;
399                     ;
400                     ;       DISPLAY BOOT ERROR
401                     ;
402                     NOOSDSK:
403   010B 211E04               LXI     H,NOOSERM
404   010E C31401               JMP     BOOTER1
405
406
407                     ;
408   0111 210E04       BOOTER: LXI     H,BOOTERM
409                     BOOTER1:
410   0114 E5                   PUSH    H
411   0115 210018               LXI     H,01800H
412   0118 220000               SHLD    CURCOL
413   011B E1                   POP     H
414   011C CD3900               CALL    DISPERR
415   011F CD0000       BOOTER2:CALL    CONIN           ; GET A CHARACTER
416   0122 FE0D                 CPI     CR
417   0124 C21F01               JNZ     BOOTER2         ; JUMP IF NOT CARRIGE RETURN
418   0127 3E18                 MVI     A,24
419   0129 CD3C00               CALL    CLRLIN          ; CLEAR LINE
420   012C 0E1A                 MVI     C,CLRSCN
421   012E CD0000               CALL    CONOUT          ; CLEAR SCREEN
422   0131 C3A900               JMP     LOADSYS         ; RETRY
423                     ;
424                     ;
425                     ;
426
427                     PAGE
```

```
                014    (NBIOS)

341
342             ;*****************************************************
343             ;*                                                   *
344             ;*   LOAD CCP AND BDOS                               *
345             ;*            START TRACK/SECTOR = 1/6               *
346             ;*                  LENGTH = 1600H                   *
347             ;*                                                   *
348             ;*****************************************************
349             ;
350             ;
351             LOADSYS:
352  00A9 1E00          MVI     E,0             ; DISK UNIT 0 DISK PARAMETER
353  00AB CD0000        CALL    DSKSET          ; SELECT DISK UNIT
354  00AE 3ACC02        LDA     RETRYC          ; SET UP RETRY COUNTER
355  00B1 47            MOV     B,A             ;
356             LOADA:
357  00B2 C5            PUSH    B               ; SAVE RETRY COUNTER
358  00B3 CD0000        CALL    READSEC1        ; READ SECTOR 1
359  00B6 C1            POP     B               ; RESTORE RETRY COUNTER
360  00B7 CAC600        JZ      LOADB           ; JUMP IF GOOD STATUS
361  00BA 0E01          MVI     C,1             ; ENRTY FOR ERROR ROUTINE
362  00BC CD0000        CALL    DSKERR          ; DETECT DISK ERRORS
363  00BF 05            DCR     B               ;
364  00C0 C2B200        JNZ     LOADA           ; JUMP IF RETRY
365  00C3 C31101        JMP     BOOTER          ; ELSE OVERRIDE
366             LOADB:
367  00C6 CD0000        CALL    CHECKOS         ;CHECK IF OS DISK LOADED
368  00C9 C20B01        JNZ     NOOSDSK         ;RETRY IF NO OS DISK LOADED
369  00CC 1E01          MVI     E,1
370  00CE CD0000        CALL    TRKSET          ; SET TRACK
371  0001 1E06          MVI     E,6
372  0003 CD0000        CALL    SECSET          ; SET SECTOR
373  00D6 1100C8        LXI     D,CCP
374  00D9 CD0000        CALL    DMASET          ; SET DMA ADDRESS
375  00DC 3E03          MVI     A,3
376  00DE 320000        STA     BTRECS
377  00E1 CD0000   LOAD1:  CALL    CREAD           ; READ SECTOR
378  00E4 C21101        JNZ     BOOTER          ; JUMP IF ERROR
379  00E7 2A0000        LHLD    PMAADR
380  00EA 110002        LXI     D,HSTSIZD
381  00ED 19            DAD     D
382  00EE 220000        SHLD    PMAADR          ; SET NEW DMA ADDRESS
383  00F1 210000        LXI     H,BTRECS
384  00F4 35            DCR     M
385  00F5 CAFF00        JZ      LOAD2           ; JUMP IF 3 SECTOR'S READ
386  00F8 210000        LXI     H,HSTSEC
387  00FB 34            INR     M               ; NEXT SECTOR #
388  00FC C3E100        JMP     LOAD1           ; READ NEXT SECTOR
389             ;
390             LOAD2:
391  00FF 1E02          MVI     E,2
392  0101 CD0000        CALL    TRKSET          ; SET TRACK #
393  0104 CD0000        CALL    RDTRAK          ; READ TRACK
394  0107 C21101        JNZ     BOOTER          ; JUMP IF ERROR
395  010A C9            RET
396                     PAGE
```

```
                        016    (NBIOS)

428
429                     ;
430                     ;
431                     ;*****************************************************************
432                     ;*              BIOS SPECIAL FUNCTION DISPATCHER                 *
433                     ;*              PARAMETER PASSING ROUTINES                       *
434                     ;*                                                               *
435                     ;*****************************************************************
436                     ;
437                     ;
438                     SPECFUN:
439   0134 79                   MOV     A,C
440   0135 87                   ADD     A
441   0136 214101               LXI     H,SPECTBL       ; SPECIAL FUNCTION TABLE ADDRESS
442   0139 CD4C03               CALL    OFST
443   013C 7E                   MOV     A,M
444   013D 23                   INX     H
445   013E 66                   MOV     H,M
446   013F 6F                   MOV     L,A
447   0140 E9                   PCHL                    ; TRANSFER TO REQUESTED FUNCTION
448
449                     SPECTBL:
450   0141 5200                 DW      RSTBDOS         ; RESET DISK STUFF
451   0143 0000                 DW      FORMATT         ; FORMAT TRACK
452   0145 0000                 DW      RDTRAK          ; READ TRACK (ONLY FLEX DISK).
453   0147 0000                 DW      DMASET          ; SET DMA ADDRESS
454   0149 0000                 DW      DSKSET          ; SELECT DISK
455   014B 0000                 DW      TRKSET          ; SET TRACK
456   014D 0000                 DW      SECSET          ; SET SECTOR
457   014F 0000                 DW      CREAD           ; READ ONE PHYSICAL SECTOR
458   0151 0000                 DW      CWRITE          ; WRITE ONE PHYSICAL SECTOR
459   0153 0000                 DW      DHOME           ; HOME DISK
460   0155 0000                 DW      DTRKSET         ; SET TRACK TWO BYTES
461   0157 0000                 DW      FREAD           ; READ SECTOR WITH ERROR RETURNED
462   0159 0000                 DW      FWRITE          ; WRITE SECTOR WITH ERROR RETURNED
463                             PAGE
```

```
                ;*****************************************************************
                ;*                                                               *
                ;*            SELECT DISK   C  = DRIVENUMBER                     *
                ;*                                                               *
                ;*****************************************************************

                SELDSK:
0158 79                 MOV     A,C             ; GET DRIVE #
015C 210A02             LXI     H,NBRFLEX       ; A(# OF DRIVES IN THE SYSTEM)
015F BE                 CMP     M
0160 D27D01             JNC     HRDDSK          ; JUMP TO CHECK IF HARD DISK ACCESS
0163 320000             STA     SEKDSK          ; SAVE SELECTED DISK
0166 CD0607             CALL    MOUNT           ; MOUNT DISK
0169 C29801             JNZ     SELCTER
016C 3A0000     GETDPH: LDA     SEKDSK
016F 87                 ADD     A               ; * 2
0170 87                 ADD     A               ; * 4
0171 87                 ADD     A               ; * 8
0172 87                 ADD     A               ; * 16
0173 210405             LXI     H,DPBASE
0176 CD4C08             CALL    OFST            ; OFFSET --) HL
0179 3A0000             LDA     SEKDSK          ; GET SELECTED DISK
017C C9                 RET
                HRDDSK:
017D 211402             LXI     H,NUMHDSK       ; TOTAL DISK NUMBER
0180 BE                 CMP     M
0181 D29801             JNC     SELCTER         ; DRIVE DOESN'T EXIST
0184 320000             STA     SEKDSK          ; SAVE SELECTED DISK
0187 CD6708             CALL    CKSEL           ; CHECK IF DISK SELECTED
018A CA6C01             JZ      GETDPH          ; JUMP IF DISK SELECTED
018D 3E03               MVI     A,3
018F CD6207             CALL    FIXINIT         ; INIT DISK
0192 CD0000             CALL    DHOME           ; RESTORE DISK TO SET STEP RATE
0195 C36C01             JMP     GETDPH
                SELCTER:
0198 210000             LXI     H,0             ; RETURN ERROR
019B AF                 XRA     A
019C 320400             STA     CURDISK         ; SELECT DRIVE A
019F C9                 RET
```

```
                    018    (NBIOS)

511
512                 ;*****************************************************************
513                 ;*                                                               *
514                 ;*      HOME    HOME THE DRIVE                                   *
515                 ;*                                                               *
516                 ;*****************************************************************
517
518                 HOME:
519   01A0 3A0000           LDA     HSTWRT          ; CHECK FOR PENDING WRITE
520   01A3 B7               ORA     A
521   01A4 C2AA01           JNZ     HOMED
522   01A7 320000           STA     HSTACT          ; CLEAR HOST ACTIVE FLAG
523   01AA C9         HOMED: RET
524
525
526                 ;*****************************************************************
527                 ;*                                                               *
528                 ;*      SETTRK  SET TRACK                                        *
529                 ;*              [BC] - TRACK NUMBER                              *
530                 ;*                                                               *
531                 ;*****************************************************************
532
533                 SETTRK:
534   01AB 69               MOV     L,C
535   01AC 60               MOV     H,B
536   01AD 220000           SHLD    SEKTRK          ; SET TRACK
537   01B0 C9               RET
538
539
540                 ;*****************************************************************
541                 ;*                                                               *
542                 ;*      SETSEC  SET SECTOR                                       *
543                 ;*              [C] - SECTOR NUMBER                              *
544                 ;*                                                               *
545                 ;*****************************************************************
546
547                 SETSEC:
548   01B1 79               MOV     A,C
549   01B2 30               DCR     A               ; START SECTOR = 0
550   01B3 320000           STA     SEKSEC          ; SET SECTOR
551   01B6 C9               RET
552
553
554                 ;*****************************************************************
555                 ;*                                                               *
556                 ;*      SETDMA  SET DMA ADDRESS                                  *
557                 ;*              [BC] - DMA ADDRESS                               *
558                 ;*                                                               *
559                 ;*****************************************************************
560
561                 SETDMA:
562   01B7 60               MOV     H,B
563   01B8 69               MOV     L,C
564   01B9 220000           SHLD    DMAADR          ; SET DMA ADDRESS
565   01BC C9               RET
566                 PAGE
```

```
567
568             ;*****************************************************************
569             ;*                                                               *
570             ;*     SECTRAN          SECTOR TRANSLATE                         *
571             ;*                                                               *
572             ;*****************************************************************
573             ;
574             ;TRANSLATE SECTORNUMBER C USING TABLE AT DE RETURN RESULT IN HL
575             ; IF DE = 0  ONLY DECREMENT SECTOR NUMBER
576
577             SECTRAN:
578  01BD 69            MOV     L,C             ; SECTOR NO. TO L
579  01BE 2600          MVI     H,0             ; CLEAR H
580  01C0 23            INX     H               ;
581  01C1 C9            RET
582
583
584
585
586
587
588             PAGE
```

```
                020    (NBIOS)

589
590             ;*****************************************************************
591             ;*                                                               *
592             ;*              MISC. SUBROUTINES                                *
593             ;*                                                               *
594             ;*****************************************************************
595
596
597             ;*****************************************************************
598             ;*                                                               *
599             ;*      MULT            MULTIPLY [A] BY [HL]                     *
600             ;*              RETURNS PRODUCT IN[HL]                           *
601             ;*                                                               *
602             ;*****************************************************************
603
604
605                             MULT:
606     01C2 C5                         PUSH    B
607     01C3 D5                         PUSH    D
608     01C4 EB                         XCHG
609     01C5 210000                     LXI     H,0
610     01C8 010008                     LXI     B,800H          ; B IS LOOP COUNTER, C IS OVERFLOW INDICATOR
611     01CB 29         MUL1:   DAD     H
612     01CC D2D001                     JNC     MUL2
613     01CF 0C                         INR     C               ; BUMP OVERFLOW
614     01D0 07         MUL2:   RLC                             ; ROTATE NEXT BIT OF MULTIPLICAND INTO CARRY
615     01D1 D2D901                     JNC     MUL3
616     01D4 19                         DAD     D
617     01D5 D2D901                     JNC     MUL3
618     01D8 0C                         INR     C
619     01D9 05         MUL3:   DCR     B
620     01DA C2CB01                     JNZ     MUL1
621     01DD 79                         MOV     A,C             ; SEE IF OVERFLOW
622     01DE B7                         ORA     A               ; TEST ZERO FLAG AND RESET CARRY
623     01DF D1                         POP     D
624     01E0 C1                         POP     B
625     01E1 C8                         RZ
626     01E2 37                         STC                     ; CARRY INDICATES OVERFLOW
627     01E3 C9                         RET
628
629
630
631                             PAGE
```

```
632
633
634                     ;*****************************************************************
635                     ;*                                                               *
636                     ;*      MOVE    MOVE [BC] BYTES FROM [HL] TO [DE]                *
637                     ;*                                                               *
638                     ;*****************************************************************
639
640
641   01E4 78           MOVE:   MOV     A,B
642   01E5 B1                   ORA     C
643   01E6 C8                   RZ                      ; RETURN IF ALL MOVED
644   01E7 ED                   DB      0EDH            ; Z80 LDIR COMMAND
645   01E8 B0                   DB      0B0H            ; (DE) (- (HL)
646   01E9 C9                   RET
647
648
649
650
651                     ;*****************************************************************
652                     ;*                                                               *
653                     ;*  MOVEL       MOVE HL - DE                                     *
654                     ;*                                                               *
655                     ;*****************************************************************
656
657
658                     MOVEL:
659   01EA 78                   MOV     A,B
660   01EB B1                   ORA     C
661   01EC C8                   RZ                      ; RETURN IF END
662   01ED ED                   DB      0EDH            ; Z80 LDDR COMMAND
663   01EE B8                   DB      0B8H            ; (DE) (- (HL) DCX H  DCX D  DCX B
664   01EF C9                   RET
665
666                     PAGE
```

```
                        022    (NBIOS)

667
668                     ;*********************************************************************
669                     ;*                                                                   *
670                     ;*   SUBHLDE    HL = HL - DE                                         *
671                     ;*                                                                   *
672                     ;*********************************************************************
673
674
675                     SUBHLDE:
676   01F0 B7                   ORA     A               ;CLEAR CARRY
677   01F1 ED                   DB      0EDH            ; Z80 SBC HL,DE COMMAND
678   01F2 52                   DB      052H            ; SUBTRACT WITH CARRY
679   01F3 C9                   RET
680
681
682
683                     ;*********************************************************************
684                     ;*                                                                   *
685                     ;*  COMPDEHL    COMPARE DE WITH HL                                   *
686                     ;*                                                                   *
687                     ;*                                        CARRY   ZERO               *
688                     ;*              DE  <  HL                  0       0                  *
689                     ;*              DE  =  HL                  0       1                  *
690                     ;*              DE  >  HL                  1       0                  *
691                     ;*                                                                   *
692                     ;*********************************************************************
693
694
695                     COMPDEHL:
696   01F4 7C                   MOV     A,H
697   01F5 BA                   CMP     D
698   01F6 D8                   RC
699   01F7 C0                   RNZ
700   01F8 7D                   MOV     A,L
701   01F9 BB                   CMP     E
702   01FA C9                   RET
703                             PAGE
```

```
704
705
706
707
708
709             ;*************************************************************************
710             ;*************************************************************************
711             ;**********                                                     **********
712             ;**********       CONFIG AREA                                   **********
713             ;**********                                                     **********
714             ;*************************************************************************
715             ;*************************************************************************
716
717  0005 =     FILLER  EQU    200H-($-ST8IOS)
718
719  01FB               DS     FILLER
720
721
722  0200 0AC2  MMAREA: DW     SPAREA          ; SPECIAL AREA (CONFIG BYTES)
723  0202 1502  MFNTBL: DW     FUNTBL          ; START ADDRESS OF FUNCTION TABLE
724  0204 1603  MCRTTBL:DW     CRTTBL          ; START OF CRT TABLE
725  0206 EE03  MKEYTBL:DW     KEYTBL          ; START OF KEYTABLE
726  0208 0E04  MMESS:  DW     ERRORMSG        ; ERROR MESSAGES
727             SPAREA:
728
729
730  020A 02    NBRFLEX:DB     2              ; # OF FLEX DRIVES
731  020B 81    IOBSET: DB     10$00$00$01B   ; INITIAL IOBYTE
732  020C 05    RETRYC: DB     5              ; RETRY COUNTER
733  0200 05    RSTC:   DB     5              ; RESTORE COUNTER
734
735  020E 03    MODEFL: DB     3              ; 0 - NO AUTO LOAD
736                                           ; 1 - AUTO LOAD ON COLD BOOT
737                                           ; 2 - AUTO LOAD ON WARM BOOT
738                                           ; 3 - AUTO LOAD ON COLD AND WARM BOOT IF
739                                           ;     CCP BUFFER LENGTH > 0
740             ;
741  020F 00    CONFIGFL:DB    0              ; CONFIGURE FLAG IF SET THEN IGNORE FNCT
742
743  0210 79    M1RS232:DB     79H            ; 1 STOP BIT , EVEN PARITY , PARITY ENABLED
744                                           ; 7 BIT CHARACTER , ASYNCHRON
745  0211 3E    M2RS232:DB     3EH            ; INTERNAL CLOCKS , 9600 BAUD
746
747  0212 01    CONFVER:DB     01H            ; VERSION NUMBER OF CONFIG
748                                           ; REL 02.03.03 HAS VER 0 ADDRESSED BY
749                                           ; PVRS232 WHICH IS UNUSED IN 02.03.03
750
751  0213 00    PVRS232:DB     00H            ; PROTOKOL VEKTOR
752
753  0214 02    NUMHDSK:DB     02             ; TOTAL NUMBER OF DRIVES HARD + FLEX DISKS
754
755                PAGE
```

```
                        024    (NBIOS)

                ;*****************************************************
                ;*****************************************************
                ;********                                     ********
                ;********       FUNCTION TABLE                ********
                ;********                                     ********
                ;*****************************************************
                ;*****************************************************
                ;
                ;
                ;


0215 =          FUNTBL  EQU     $

0215 08         F1:     DB LEN1
0216 4449522041         DB      'DIR A:',CR
0008 =          LEN1    EQU     $-F1


0210 08         F2:     DB      LEN2
021E 464F524D41         DB      'FORMAT',CR
0008 =          LEN2    EQU     $-F2


0225 08         F3:     DB      LEN3
0226 5359534745         DB      'SYSGEN',CR
0008 =          LEN3    EQU     $-F3


0220 11         F4:     DB      LEN4
022E 5049502042         DB      'PIP B:=A:*.*[V]',CR
0011 =          LEN4    EQU     $-F4


023E 08         F5:     DB      LEN5
023F 4449522042         DB      'DIR B:',CR
0008 =          LEN5    EQU     $-F5


0246 08         F6:     DB      LEN6
0247 434F4E4649         DB      'CONFIG',CR
0008 =          LEN6    EQU     $-F6


                        PAGE
```

```
                        025    (NBIOS)

801
802   024E 08         F7:     DB      LEN7
803   024F 4449534349         DB      'DISCIT',CR
804   0008 =          LEN7    EQU     $-F7
805
806   0256 11         F8:     DB      LEN8
807   0257 5049502041         DB      'PIP A:=B:*.*[V]',CR
808   0011 =          LEN8    EQU     $-F8
809
810
811   0267 0A         F9:     DB      LEN9
812   0268 4558434841         DB      'EXCHANGE',CR
813   000A =          LEN9    EQU     $-F9
814
815
816   0271 09         F10:    DB      LEN10
817   0272 5354415420         DB      'STAT A:',CR
818   0009 =          LEN10   EQU     $-F10
819
820
821   027A 0C         F11:    DB LEN11
822   027B 5354415420         DB      'STAT B:*.*',CR
823   000C =          LEN11   EQU     $-F11
824
825
826   0286 04         F12:    DB      LEN12
827   0287 463132             DB      'F12'
828   0004 =          LEN12   EQU     $-F12
829
830
831   028A 04         F13:    DB      LEN13
832   028B 463133             DB      'F13'
833   0004 =          LEN13   EQU     $-F13
834
835
836   028E 08         F14:    DB      LEN14
837   028F 4C4144444F         DB      'LADDER',CR
838   0008 =          LEN14   EQU     $-F14
839
840
841   0296 09         F15:    DB      LEN15
842   0297 4341544348         DB      'CATCHUM',CR
843   0009 =          LEN15   EQU     $-F15
844
845
846   029F 07         F16:    DB      LEN16
847   02A0 4445D04F35         DB      'DEMO5',CR
848   0007 =          LEN16   EQU     $-F16
849
850                             PAGE
```

```
                        026     (NBIOS)

851
852   02A6 07           F17:    DB      LEN17
853   02A7 434C4F434B           DB      'CLOCK',CR
854   0007 =            LEN17   EQU     $-F17
855
856   02AD 07           F18:    DB      LEN18
857   02AE 4D55534943           DB      'MUSIC',CR
858   0007 =            LEN18   EQU     $-F18
859
860
861   02B4 07           F19:    DB      LEN19
862   02B5 5645474153           DB      'VEGAS',CR
863   0007 =            LEN19   EQU     $-F19
864
865
866   02BB 04           F20:    DB      LEN20
867   02BC 463230               DB      'F20'
868   0004 =            LEN20   EQU     $-F20
869
870   02BF 00           F21:    DB      0                       ; LAST FUNCTION
871
872   0055 =            FFILLER EQU     256-($-FUNTBL)          ; TOTAL FUNTBL HAS 256 BYTES
873   02C0                      DS      FFILLER
874   0315 00           FNTBLND:DB      0                       ; END OF FUNCTION TABLE
875
876                             PAGE
```

```
                        ;*************************************************************
                        ;*                                                           *
                        ;*              LANGUAGE TRANSLATION TABLE                   *
                        ;*                                                           *
                        ;*************************************************************



                        CRTTBL:                 ; START OF TRANSLATION TABLE
                                                ;
                                                ;
                                                ;
0316 03                 LVAR0:  DB      VAR0L
0317 8A2E               US:     DB      8AH,2EH
0003 =                  VAR0L   EQU     $-LVAR0

0319 07                 LVAR1:  DB      VAR1L
031A 5E0E23038AUK:      DB      5EH,0EH,23H,03H,8AH,2EH
0007 =                  VAR1L   EQU     $-LVAR1

0320 15                 LVAR2:  DB      VAR2L
0321 5B0D5C085DFRANCE:  DB      5BH,0DH,5CH,08H,5DH,1CH,40H,0AH,7BH,14H,7CH,1AH
032D 7D0B7E0F23         DB      7DH,0BH,7EH,0FH,23H,03H,27H,0CH
0015 =                  VAR2L   EQU     $-LVAR2

0335 13                 LVAR3:  DB      VAR3L
0336 5B005C065DGERMANY: DB      5BH,00H,5CH,06H,5DH,09H,40H,1CH,7BH,10H,7CH,16H
0342 70197E1E27         DB      7DH,19H,7EH,1EH,27H,0CH
0013 =                  VAR3L   EQU     $-LVAR3

0348 13                 LVAR4:  DB      VAR4L
0349 5B005C065DSWEDEN:  DB      5BH,00H,5CH,06H,5DH,02H,24H,13H,7BH,10H,7CH,16H
0355 7D127E0F27         DB      7DH,12H,7EH,0FH,27H,0CH
0013 =                  VAR4L   EQU     $-LVAR4

0358 13                 LVAR5:  DB      VAR5L
035C 5B015C075DDANSK:   DB      5BH,01H,5CH,07H,5DH,02H,23H,03H,7BH,11H,7CH,17H
0368 7D127E0F27         DB      7DH,12H,7EH,0FH,27H,0CH
0013 =                  VAR5L   EQU     $-LVAR5

036E 0D                 LVAR6:  DB      VAR6L
036F 5B1F5C055DKSPAIN:  DB      5BH,1FH,5CH,05H,5DH,1DH,27H,0CH,7CH,15H,23H,03H
000D =                  VAR6L   EQU     $-LVAR6

0378 17                 LVAR7:  DB      VAR7L
037C 5B0D5C085DITALY:   DB      5BH,0DH,5CH,08H,5DH,14H,23H,03H,40H,1CH,7BH,0AH
0388 7C187D0B7E         DB      7CH,18H,7DH,0BH,7EH,1BH,60H,1AH,27H,0CH
0017 =                  VAR7L   EQU     $-LVAR7

0392 15                 LVAR8:  DB      VAR8L
0393 2303270C40SWISS12: DB      23H,03H,27H,0CH,40H,08H,5BH,0AH,5CH,14H,5DH,08H
039F 7B107C167D         DB      7BH,10H,7CH,16H,7DH,19H,7EH,0FH
0015 =                  VAR8L   EQU     $-LVAR8
```

```
                        028     (NBIOS)

933
934   03A7 01           LVAR9:  DB      VAR9L
935                     CANADA1:
936   0001 =            VAR9L   EQU     $-LVAR9
937
938   03A8 0F           LVAR10: DB      VAR10L
939   03A9 270C400A5CCANADA2:DB         27H,0CH,40H,0AH,5CH,08H,7BH,14H,7CH,9FH,7DH,0BH
940   0385 7E0F               DB        7EH,0FH
941   000F =            VAR10L  EQU     $-LVAR10
942
943   0387 11           LVAR11: DB      VAR11L
944   0388 270C5B835CSAFRICA:DB         27H,0CH,5BH,83H,5CH,84H,5DH,82H,7BH,93H
945   03C2 7C947D927C         DB        7CH,94H,7DH,92H,7EH,0FH
946   0011 =            VAR11L  EQU     $-LVAR11
947
948   03C8 11           LVAR12: DB      VAR12L
949   03C9 2303270C5BPORTUG: DB         23H,03H,27H,0CH,5BH,80H,5CH,81H,5DH,85H,7BH,90H
950   03D5 7C917D08           DB        7CH,91H,7DH,08H
951   0011 =            VAR12L  EQU     $-LVAR12
952
953   03D9 15           LVAR13: DB      VAR13L
954   03DA 408C5B8B5CYUGOSL: DB         40H,8CH,5BH,8BH,5CH,88H,5DH,89H,5EH,8AH,60H,9CH
955   03E6 7B9B7C987D         DB        7BH,9BH,7CH,98H,7DH,99H,7EH,9AH
956   0015 =            VAR13L  EQU     $-LVAR13
957
958                             PAGE
```

```
959
960                ;*********************************************************************
961                ;*                                                                   *
962                ;*        KEYBOARD TRANSLATION TABLE                                 *
963                ;*                        80H-9FH                                    *
964                ;*********************************************************************
965
966
967                KEYTBL:
968
969  03EE 80             DB      80H             ; 80H
970  03EF 17             DB      17H             ; 81H  HOME
971  03F0 13             DB      13H             ; 82H  CURSOR LEFT
972  03F1 18             DB      18H             ; 83H  CURSOR DOWN
973  03F2 05             DB      05H             ; 84H  CURSOR UP
974  03F3 04             DB      04H             ; 85H  CURSOR RIGTH
975  03F4 18             DB      18H             ; 86H  CLR
976  03F5 87             DB      87H             ; 87H
977  03F6 0D             DB      0DH             ; 88H   CARRIGE RETURN
978  03F7 89             DB      89H             ; 89H
979  03F8 2C             DB      2CH             ; 8AH   COMMA
980  03F9 08             DB      08H             ; 8BH   BACKSPACE
981  03FA 8C             DB      8CH             ; 8CH
982  03FB 8D             DB      8DH             ; 8DH
983  03FC 8E             DB      8EH             ; 8EH
984  03FD 8F             DB      8FH             ; 8FH
985                                                 CONTROL
986  03FE 90             DB      90H             ; 90H
987  03FF 17             DB      17H             ; 91H  HOME
988  0400 13             DB      13H             ; 92H  <-
989  0401 18             DB      18H             ; 93H  v
990  0402 05             DB      05H             ; 94H  ^
991  0403 04             DB      04H             ; 95H  ->
992  0404 18             DB      18H             ; 96H  CLR
993  0405 97             DB      97H             ; 97H
994  0406 0D             DB      0DH             ; 98H   CARRIGE RETURN
995  0407 99             DB      99H             ; 99H
996  0408 2C             DB      2CH             ; 9AH   COMMA
997  0409 08             DB      08H             ; 9BH   BACKSPACE
998  040A 9C             DB      9CH             ; 9CH
999  040B 9D             DB      9DH             ; 9DH
1000 040C 9E             DB      9EH             ; 9EH
1001 040D 9F             DB      9FH             ; 9FH
1002                     PAGE
```

```
1025
1026                    ;*****************************************************************
1027                    ;*              DISK DEFINITIONS                                 *
1028                    ;*****************************************************************
1029
1030                    DPBASE:
1031
1032                            DISKS   10                      ; 10  DISKS ( 2 FLEX , 8 HARD )
1033    0504+=          DPBASE  EQU     $       ;BASE OF DISK PARAMETER BLOCKS
1034    0504+00000000   DPE0:   DW      0000H,0000H     ;TRANSLATE TABLE
1035    0508+00000000           DW      0000H,0000H     ;SCRATCH AREA
1036    050C+00FA99FE           DW      DIRBUF,DPB0     ;DIR BUFF,PARM BLOCK
1037    0510+A0FA80FA           DW      CSV0,ALV0       ;CHECK, ALLOC VECTORS
1038    0514+00000000   DPE1:   DW      0000H,0000H     ;TRANSLATE TABLE
1039    0518+00000000           DW      0000H,0000H     ;SCRATCH AREA
1040    051C+00FAA8FE           DW      DIRBUF,DPB1     ;DIR BUFF,PARM BLOCK
1041    0520+31FBE0FA           DW      CSV1,ALV1       ;CHECK, ALLOC VECTORS
1042    0524+00000000   DPE2:   DW      0000H,0000H     ;TRANSLATE TABLE
1043    0528+00000000           DW      0000H,0000H     ;SCRATCH AREA
1044    052C+00FA87FE           DW      DIRBUF,DPB2     ;DIR BUFF,PARM BLOCK
1045    0530+000071FB           DW      CSV2,ALV2       ;CHECK, ALLOC VECTORS
1046    0534+00000000   DPE3:   DW      0000H,0000H     ;TRANSLATE TABLE
1047    0538+00000000           DW      0000H,0000H     ;SCRATCH AREA
1048    053C+00FAC6FE           DW      DIRBUF,DPB3     ;DIR BUFF,PARM BLOCK
1049    0540+0000C2FB           DW      CSV3,ALV3       ;CHECK, ALLOC VECTORS
1050    0544+00000000   DPE4:   DW      0000H,0000H     ;TRANSLATE TABLE
1051    0548+00000000           DW      0000H,0000H     ;SCRATCH AREA
1052    054C+00FAD5FE           DW      DIRBUF,DPB4     ;DIR BUFF,PARM BLOCK
1053    0550+000013FC           DW      CSV4,ALV4       ;CHECK, ALLOC VECTORS
1054    0554+00000000   DPE5:   DW      0000H,0000H     ;TRANSLATE TABLE
1055    0558+00000000           DW      0000H,0000H     ;SCRATCH AREA
1056    055C+00FAE4FE           DW      DIRBUF,DPB5     ;DIR BUFF,PARM BLOCK
1057    0560+000064FC           DW      CSV5,ALV5       ;CHECK, ALLOC VECTORS
1058    0564+00000000   DPE6:   DW      0000H,0000H     ;TRANSLATE TABLE
1059    0568+00000000           DW      0000H,0000H     ;SCRATCH AREA
1060    056C+00FAF3FE           DW      DIRBUF,DPB6     ;DIR BUFF,PARM BLOCK
1061    0570+0000B5FC           DW      CSV6,ALV6       ;CHECK, ALLOC VECTORS
1062    0574+00000000   DPE7:   DW      0000H,0000H     ;TRANSLATE TABLE
1063    0578+00000000           DW      0000H,0000H     ;SCRATCH AREA
1064    057C+00FA02FF           DW      DIRBUF,DPB7     ;DIR BUFF,PARM BLOCK
1065    0580+000006FD           DW      CSV7,ALV7       ;CHECK, ALLOC VECTORS
1066    0584+00000000   DPE8:   DW      0000H,0000H     ;TRANSLATE TABLE
1067    0588+00000000           DW      0000H,0000H     ;SCRATCH AREA
1068    058C+00FA11FF           DW      DIRBUF,DPB8     ;DIR BUFF,PARM BLOCK
1069    0590+000057FD           DW      CSV8,ALV8       ;CHECK, ALLOC VECTORS
1070    0594+00000000   DPE9:   DW      0000H,0000H     ;TRANSLATE TABLE
1071    0598+00000000           DW      0000H,0000H     ;SCRATCH AREA
1072    059C+00FA20FF           DW      DIRBUF,DPB9     ;DIR BUFF,PARM BLOCK
1073    05A0+0000A8FD           DW      CSV9,ALV9       ;CHECK, ALLOC VECTORS
1074
1075
1076
1077
1078
1079                            PAGE
```

```
                    030    (NBIOS)

1003
1004                ;*****************************************************************
1005                ;*                                                               *
1006                ;*  ERROR MESSAGES                                               *
1007                ;*                                                               *
1008                ;*****************************************************************
1009
1010
1011                ERRORMSG:
1012
1013  040E 424F4F5420BOOTERM:DB      'BOOT ERROR (CR)$'
1014  041E 413A204D4FMOOSERM:DB      'A: MOUNT O.S. DISK (CR)$'
1015  0436 203A204E4FNOTRDYM:DB      ' : NOT READY (R)$'
1016  0447 203A204E4FNRDYRX: DB      ' : NOT READY (R/X)$'
1017  045A 203A205752WRPRCTM:DB      ' : WRITE PROTECT (R/O/X)$'
1018  0473 203A20492FIOERRM: DB      ' : I/O ERROR (R/O/X)$'
1019  0488 203A204641FATERRM:DB      ' : FATAL ERROR (R/O/X)$'
1020  049F 464E435420FNCERRM: DB     'FNCT TABLE FULL (CR)$'
1021  0484                   DS      80              ; PATCH AREA
1022
1023
1024                           PAGE
```

```
                032    (NBIOS)

1080
1081            ;*****************************************************************
1082            ;*              DISK DEBLOCKING MACROS                           *
1083            ;*****************************************************************
1084
1085            ;       UTILITY MACRO TO COMPUTE SECTOR MASK
1086
1087            SMASK   MACRO   HBLK            ;; COMPUTE LOG2(HBLK) RETURN @X
1088            @Y      SET     HBLK
1089            @X      SET     0
1090                    REPT    8
1091                    IF      @Y = 1
1092                    EXITM
1093                    ENDIF
1094            ;;      @Y IS NOT 1, SHIFT RIGHT ONE POSITION
1095                    @Y      SET     @Y SHR 1
1096                    @X      SET     @X + 1
1097                    ENDM
1098                    ENDM
1099
1100                    HOSTDEQU
1101    0800+=          BLKSIZ  EQU     2048            ;CP/M ALLOCATION SIZE
1102    0200+=          HSTSIZD EQU     512             ;HOST DISK SECTOR SIZE
1103    0008+=          HSTSPTD EQU     08              ;HOST DISK SECTORS/TRK
1104    0004+=          HSTBLKD EQU     HSTSIZD/128     ;CP/M SECTS/HOST BUFF
1105    0020+=          CPMSPTD EQU     HSTBLKD * HSTSPTD       ;CP/M SECTORS/TRACK
1106    0003+=          SECMSKD EQU     HSTBLKD-1       ;SECTOR MASK
1107    0002+=          SECSHFD EQU     @X              ;LOG2(HSTBLK)
1108
1109
1110
1111                    WRITEEEQ
1112    0000+=          WRALL   EQU     0               ;WRITE TO ALLOCATED
1113    0001+=          WRDIR   EQU     1               ;WRITE TO DIRECTORY
1114    0002+=          WRUAL   EQU     2               ;WRITE TO UNALLOCATED
```

```
1115
1116
1117
1118                ;*****************************************************************
1119                ;*                                                               *
1120                ;*   READ      LOGICAL READ ROUTINE                              *
1121                ;*                                                               *
1122                ;*****************************************************************
1123
1124
1125                READ:                           ; READ THE SELECTED CP/M SECTOR
1126   05A4 AF              XRA     A
1127   05A5 32000G          STA     UNACNT
1128   05A8 3E01            MVI     A,1
1129   05AA 320000          STA     READOP          ; READ OPERATION
1130   05AD 320000          sta     rsflag          ;must read data
1131   05B0 3E02            mvi     a,wrual
1132   05B2 320000          sta     wrtype          ;treat as unalloc
1133   05B5 C32206          jmp     rwoper          ;to perform the read
1134                ;
1135                ;*****************************************************************
1136                ;*                                                               *
1137                ;*   WRITE     LOGICAL WRITE ROUTINE                             *
1138                ;*                                                               *
1139                ;*****************************************************************
1140
1141                WRITE:
1142                        ;write the selected CP/M sector
1143   05B8 AF              xra     a               ;0 to accumulator
1144   05B9 320000          sta     readop          ;not a read operation
1145   05BC 79              mov     a,c             ;write type in c
1146   05BD 320000          sta     wrtype
1147   05C0 FE02            cpi     wrual           ;write unallocated?
1148   05C2 C2DE05          jnz     chkuna          ;check for unalloc
1149                ;
1150                ;       write to unallocated, set parameters
1151   05C5 210000          LXI     H,SEKDSK        ; FETCH BLOCKSIZE / 128
1152   05C8 4E              MOV     C,M
1153   05C9 210108          LXI     H,DSKCNT
1154   05CC CD5207          CALL    DSKGET
1155   05CF 79              MOV     A,C             ;next unalloc recs
1156   05D0 320000          sta     unacnt
1157   05D3 210000          LXI     H,sekdsk        ;
1158   05D6 110000          LXI     D,unadsk        ;unadsk = sekdsk
1159   05D9 010400          LXI     B,4             ;unatrk = sectrk
1160   05DC ED              DB      0EDH            ;unasec = seksec
1161   05DD B0              DB      0B0H            ; Z80 LDIR COMMAND
1162
1163
1164                        PAGE
```

```
                        :034    (NBIOS)

1165
1166                    chkuna:
1167                            ;check for write to unallocated sector
1168    050E 3A0000             lda     unacnt          ;any unalloc remain?
1169    05E1 B7                 ora     a
1170    05E2 CA1A06             jz      alloc           ;skip if not
1171                    ;
1172                    ;       more unallocated records remain
1173    05E5 3D                 dcr     a               ;unacnt = unacnt-1
1174    05E6 320000             sta     unacnt
1175                    ;
1176    05E9 210000             LXI     H,UNADSK        ; COMPARE DSK, TRK, SEC
1177    05EC 110000             LXI     D,SEKDSK
1178    05EF 0604               MVI     B,4
1179    05F1 CD5D08             CALL    CMPRE
1180    05F4 C21A06             JNZ     ALLOC
1181    05F7 2B                 DCX     H
1182
1183                    ;
1184                    ;       match, move to next sector for future ref
1185    05F8 34                 inr     m               ;unasec = unasec+1
1186    05F9 E5                 PUSH    H               ;end of track?
1187    05FA 210000             LXI     H,UNADSK        ; FETCH CP/M SECTORS PER TRACK
1188    05FD 4E                 MOV     C,M
1189    05FE 21C107             LXI     H,DSKSPT
1190    0601 CD5207             CALL    DSKGET
1191    0604 E1                 POP     H
1192    0605 7E                 MOV     A,M
1193    0606 B9                 CMP     C
1194    0607 DA1306             jc      noovf           ;skip if no overflow
1195                    ;
1196                    ;       overflow to next track
1197    060A 3600               mvi     m,0             ;unasec = 0
1198    060C 2A0000             lhld    unatrk
1199    060F 23                 inx     h
1200    0610 220000             shld    unatrk          ;unatrk = unatrk+1
1201                    ;
1202                    noovf:
1203                            ;match found, mark as unnecessary read
1204    0613 AF                 xra     a               ;0 to accumulator
1205    0614 320000             sta     rsflag          ;rsflag = 0
1206    0617 C32206             jmp     ruoper          ;to perform the write
1207                    ;
1208                    alloc:
1209                            ;not an unallocated record, requires pre-read
1210    061A AF                 xra     a               ;0 to accum
1211    061B 320000             sta     unacnt          ;unacnt = 0
1212    061E 3C                 inr     a               ;1 to accum
1213    061F 320000             sta     rsflag          ;rsflag = 1
1214
1215
1216                            PAGE
```

```
1217
1218                    ;*********************************************************
1219                    ;*                                                       *
1220                    ;*      Common code for READ and WRITE follows           *
1221                    ;*                                                       *
1222                    ;*********************************************************
1223                    rwoper:
1224                            ;enter here to perform the read/write
1225    0622 AF                 xra     a               ;zero to accum
1226    0623 320000             sta     erflag          ;no errors (yet)
1227    0626 210000             LXI     H,SEKDSK        ; FETCH CODED SECTORLENGTH
1228    0629 4E                 MOV     C,M
1229    062A 218907             LXI     H,DSKSLC
1230    062D CD5207             CALL    DSKGET
1231    0630 0C                 INR     C
1232    0631 3A0000             LDA     SEKSEC          ; COMPUTE HOST SECTOR
1233    0634 C33906             JMP     SHIFTE
1234    0637 B7         SHIFT:  ORA     A               ; CARRY = 0
1235    0638 1F                 RAR                     ; SHIFT RIGHT
1236    0639 0D         SHIFTE: DCR     C               ; DECREMENT LOOP COUNTER
1237    063A C23706             JNZ     SHIFT
1238    063D 320000             sta     sekhst          ;host sector to seek
1239                    ;
1240                    ;       active host sector?
1241    0640 210000             lxi     h,hstact        ;host active flag
1242    0643 7E                 mov     a,m
1243    0644 3601               mvi     m,1             ;always becomes 1
1244    0646 B7                 ora     a               ;was it already?
1245    0647 CA6906             jz      filhst          ;fill host if not
1246                    ;
1247                    ;       host buffer active, same as seek buffer?
1248    064A 210000             LXI     H,HSTDSK        ;COMPARE DSK AND TRK
1249    064D 110000             LXI     D,SEKDSK
1250    0650 0603               MVI     B,3
1251    0652 CD5D08             CALL    CMPRE
1252    0655 C26206             JNZ     NOMATCH
1253                    ;
1254                    ;       same disk, same track, same buffer?
1255    0658 3A0000             lda     sekhst
1256    065B 210000             lxi     h,hstsec        ;sekhst = hstsec?
1257    065E BE                 cmp     m
1258    065F CA8606             jz      match           ;skip if match
1259                    ;
1260                    nomatch:
1261                            ;proper disk, but not correct sector
1262    0662 3A0000             lda     hstwrt          ;host written?
1263    0665 B7                 ora     a
1264    0666 C41807             cnz     writehst        ;clear host buff
1265                    ;
1266                    filhst:
1267                            ;may have to fill the host buffer
1268    0669 3A0000             lda     sekdsk
1269    066C 320000             sta     hstdsk
1270    066F 2A0000             lhld    sektrk
1271    0672 220000             shld    hsttrk
1272    0675 3A0000             lda     sekhst
```

```
                        036     (NBIOS)

1273    0678 320000             sta     hstsec
1274    067B 3A0000             lda     rsflag          ;need to read?
1275    067E B7                 ora     a
1276    067F C41A07             cnz     readhst         ;yes, if 1
1277    0682 AF                 xra     a               ;0 to accum
1278    0683 320000             sta     hstwrt          ;no pending write
1279                    ;
1280                    match:
1281                            ;copy data to or from buffer
1282    0686 210000             LXI     H,HSTDSK
1283    0689 4E                 MOV     C,M
1284    068A 21B007             LXI     H,DSKSMA        ;GET SECTORMASK FROM TABLE
1285    068D CD5207             CALL    DSKGET
1286    0690 3A0000             lda     seksec          ;mask buffer number
1287    0693 A1                 ANA     C               ;least signif bits
1288    0694 6F                 mov     l,a             ;ready to shift
1289    0695 2600               mvi     h,0             ;double count
1290                            rept    7               ;shift left 7
1291                            dad     h
1292                            endm
1293    0697+29                 DAD     H
1294    0698+29                 DAD     H
1295    0699+29                 DAD     H
1296    069A+29                 DAD     H
1297    069B+29                 DAD     H
1298    069C+29                 DAD     H
1299    069D+29                 DAD     H
1300                    ;       hl has relative host buffer address
1301    069E 1100F6             lxi     d,hstbuf
1302    06A1 19                 dad     d               ;hl = host address
1303    06A2 EB                 xchg                    ;now in DE
1304    06A3 2A0000             lhld    dmaadr          ;get/put CP/M data
1305    06A6 018000             LXI     B,128           ;length of move
1306    06A9 3A0000             lda     readop          ;which way?
1307    06AC B7                 ora     a
1308    06AD C2B606             jnz     rwmove          ;skip if read
1309                    ;
1310                    ;       write operation, mark and switch direction
1311    06B0 3E01               mvi     a,1
1312    06B2 320000             sta     hstwrt          ;hstwrt = 1
1313    06B5 EB                 xchg                    ;source/dest swap
1314                    ;
1315                    rwmove:
1316                            ;C initially 128, DE is source, HL is dest
1317    06B6 EB                 XCHG                    ;SOURCE / DESTINATION SWAP
1318    06B7 ED                 DB      0EDH            ;Z80 LDIR COMMAND (DE) <- (HL)
1319    06B8 B0                 DB      0B0H
1320                    ;
1321                    ;       CHECK IF DATA CONVERSATION IS REQUIRED
1322                    ;
1323    06B9 E5                 PUSH    H               ;SAVE HL
1324    06BA 210000             LXI     H,HSTDSK
1325    06BD 4E                 MOV     C,M             ;GET DISK NUMBER
1326    06BE 21B507             LXI     H,DSKSID
1327    06C1 CD5207             CALL    DSKGET          ;GET SPECIAL BYTE
1328    06C4 E1                 POP     H               ;RESTORE HL
```

```
1329  06C5 79          MOV   A,C
1330  06C6 07          RLC
1331  06C7 D2D706      JNC   RWM1          ;JUMP IF NO CONVERSION REQ.
1332  06CA 2B          DCX   H             ;CORRECT SOURCE ADDRESS
1333  06CB 1B          DCX   D             ;CORRECT DESTINATION ADDRESS
1334  06CC 0680        MVI   B,128
1335             RWM2:
1336  06CE 7E          MOV   A,M
1337  06CF 2F          CMA                 ;COMPLEMENT IT
1338  06D0 12          STAX  D
1339  06D1 2B          DCX   H
1340  06D2 1B          DCX   D
1341  06D3 05          DCR   B
1342  06D4 C2CE06      JNZ   RWM2          ;MOVE 128 BYTES
1343             RWM1:
1344             ;
1345             ;       data has been moved to/from host buffer
1346             ;
1347  06D7 3A0000      lda   wrtype        ;write type
1348  06DA FE01        cpi   wrdir         ;to directory?
1349  06DC 3A0000      LDA   ERFLAG
1350  06DF C2EE06      JNZ   RWEMD         ;END OF THE R/W OPERATION
1351             ;
1352             ;       clear host buffer for directory write
1353  06E2 B7          ora   a             ;errors?
1354  06E3 C0          RNZ                 ;skip if so
1355  06E4 AF          xra   a             ;0 to accum
1356  06E5 320000      sta   hstwrt        ;buffer written
1357  06E8 CD1807      call  writehst
1358  06EB 3A0000      lda   erflag
1359  06EE B7      RWEMD: ORA   A          ;SET STATUS
1360  06EF C9          ret
1361             ;
1362             ;
1363             PAGE
```



```
1364
1365
1366  06F0 3A0000  FLUSH: LDA   HSTWRT
1367  06F3 B7          ORA   A
1368  06F4 C8          RZ                  ; RETURN IF NO WRITE PENDING
1369  06F5 CDFB06      CALL  CLOSE         ; CLOSE IF NO WRITE PENDING
1370  06F8 C31807      JMP   WRITEHST
1371
1372  06FB AF      CLOSE: XRA   A
1373  06FC 320000      STA   UNACNT        ; RESET UNALLOCATED COUNTER
1374  06FF 320000      STA   HSTACT        ; RESET HOST ACTIVE FLAG
1375  0702 320000      STA   HSTWRT        ; RESET HOST WRITE PENDING FLAG
1376  0705 C9          RET
1377             PAGE
```

```
                    039    (NBIOS)

1378
1379                ;*****************************************************************
1380                ;*                                                               *
1381                ;*      MOUNT   SELECT DRIVE                                     *
1382                ;*                                                               *
1383                ;*****************************************************************
1384
1385
1386                MOUNT:
1387  0706 CD6708           CALL    CKSEL           ; CHECK IF DISK SELECTED
1388  0709 C8               RZ                      ; DRIVE IS ALREADY INITIALIZED
1389  070A CDF006           CALL    FLUSH           ; WRITE OUT BUFFER IF PENDING
1390  070D CDFB06           CALL    CLOSE           ; AND CLOSE IF READ
1391  0710 3A0000           LDA     SEKDSK
1392  0713 4F               MOV     C,A             ; DRIVE NO. IN C
1393  0714 CD6F07           CALL    FDINIT          ; TRY TO INITIALIZE DISK
1394  0717 C9               RET                     ; FDINIT RETURNS ZERO IF O.K.
1395
1396
1397
1398
1399                        PAGE
```

```
1400
1401
1402
1403
1404                ;*****************************************************************
1405                ;*                                                               *
1406                ;*      HOST DISK READ / WRITE                                   *
1407                ;*                                                               *
1408                ;*****************************************************************
1409
1410
1411                WRITEHST:
1412  0718 AF               XRA     A               ; WRITE HOST
1413  0719 21               DB      21H             ; EXCHANGES THE REQ. "JMP"
1414                READHST:                        ; READ HOST
1415  071A 3E01             MVI     A,1
1416  071C 320000           STA     DSKCMD
1417
1418  071F 3A0000           LDA     HSTDSK          ; TEST IF SECTOR TRANSLATE NECESSARY
1419  0722 4F               MOV     C,A
1420  0723 21F007           LXI     H,DSKDBL
1421  0726 CD5207           CALL    DSKGET
1422  0729 79               MOV     A,C             ; GET BYTE
1423  072A B7               ORA     A
1424  072B 3A0000           LDA     HSTSEC
1425  072E 320000           STA     SAVESEC         ; SAVE HSTSEC
1426  0731 CA3E07           JZ      DSKOP2          ; ZERO = 1 -) NO TRANSLATE ( INCREMENT)
1427  0734 211108           LXI     H,XLT           ; LOAD TRANSLATE TABLE ADDRESS
1428  0737 CD4C08           CALL    OFST            ; ADD SECTORNO TO STARTADDRESS
1429  073A 7E               MOV     A,M             ; GET TRANSLATED SECTOR
1430  073B C33F07           JMP     DSKOP3
1431  073E 3C       DSKOP2: INR     A               ; INCREMENT SECTOR NO
1432  073F 320000   DSKOP3: STA     HSTSEC          ; STORE SECTORNO
1433  0742 2100F6           LXI     H,HSTBUF
1434  0745 220000   DSKOP1: SHLD    PMAADR          ; SET DMA - ADDRESS
1435  0748 CD0000           CALL    DISKIO          ; CALL DISKROUTINES
1436  074B 3A0000           LDA     SAVESEC         ; FETCH OLD HSTSEC
1437  074E 320000           STA     HSTSEC          ; RESTORE IT
1438  0751 C9               RET
1439                PAGE
```

```
                041    (NBIOS)

1440
1441            ;
1442            ;*****************************************************************
1443            ;*                                                               *
1444            ;*      DSKGET RETURNS A VALUE FROM THE DISK TYPE TABLE          *
1445            ;*      C:= (DSKxxx + (DSKTYP + DISKNO.))                        *
1446            ;*                                                               *
1447            ;*      IN:     HL = DSKxxx                                      *
1448            ;*               C = DISKNO.                                     *
1449            ;*      OUT      C = VALUE FROM TABLE                            *
1450            ;*               B = 0                                           *
1451            ;*      CHANGED REG.  BC         UNCHANGED     A  DE  HL         *
1452            ;*                                                               *
1453            ;*****************************************************************
1454
1455   0752 D5      DSKGET: PUSH    D               ; SAVE DE
1456   0753 113108          LXI     D,DSKTYP        ; TYPE TABLE
1457   0756 0600            MVI     B,0             ; EXPAND DISKNO.
1458   0758 EB              XCHG                    ;
1459   0759 09              DAD     B               ; HL = DSKTYP + DISKNO
1460   075A 5E              MOV     L,M             ; L = TYP (DISKNO.)
1461   075B 2600            MVI     H,0             ; EXPAND TYPE
1462   075D 19              DAD     D               ; HL = DSKxxx + (DSKTYP + DISKNO.)
1463   075E 4E              MOV     C,M             ; C = RESULT
1464   075F EB              XCHG                    ; DSKxxx IN HL AGAIN
1465   0760 D1              POP     D               ; RESTORE DE
1466   0761 C9              RET
1467
1468                 PAGE
```

```
1469
1470
1471                    ;*****************************************************************
1472                    ;*                                                               *
1473                    ;*      FIXINIT INITILAIZES DRIVE WITH FIXED TYPE                *
1474                    ;*      STORES TYPE IN DSKTYP TABLE AND EXCHANGES PARAMETERS IN  *
1475                    ;*      DPEx AND DPBx TABLES                                     *
1476                    ;*                                                               *
1477                    ;*      IN:     C = DISKNO.                                      *
1478                    ;*              A = TYP                                          *
1479                    ;*                                                               *
1480                    ;*      CHANGED REG.  A  BC  DE  HL    UNCHANGED                 *
1481                    ;*                                                               *
1482                    ;*****************************************************************
1483                    ;
1484  0762 210000       FIXINIT:LXI     H,HSTDSK
1485  0765 71                   MOV     M,C             ; SAVE DISKNO.
1486  0766 0600                 MVI     B,0
1487  0768 213108               LXI     H,DSKTYP
1488  076B 09                   DAD     B
1489  076C C38107               JMP     EXTINI          ; FILL UP TABLES
1490
1491
1492                    ;*****************************************************************
1493                    ;*                                                               *
1494                    ;*      FDINIT INITILAIZES DRIVE                                 *
1495                    ;*      STORES TYPE IN DSKTYP TABLE AND EXCHANGES PARAMETERS IN  *
1496                    ;*      DPEx AND DPBx TABLES                                     *
1497                    ;*                                                               *
1498                    ;*      IN:     C = DISKNO.                                      *
1499                    ;*      OUT     ZERO = O.K                                       *
1500                    ;*              NOT ZERO = ERROE                                 *
1501                    ;*      CHANGED REG.  A  BC  DE  HL    UNCHANGED                 *
1502                    ;*                                                               *
1503                    ;*****************************************************************
1504
1505  076F 210000       FDINIT: LXI     H,HSTDSK        ; SAVE DRIVENO.
1506  0772 71                   MOV     M,C
1507  0773 0600                 MVI     B,0             ; EXTEND DRIVENO
1508  0775 213108               LXI     H,DSKTYP        ; STARTING ADDRESS OF DISK TYPE TABLE
1509  0778 09                   DAD     B               ;
1510  0779 E5                   PUSH    H               ; SAVE ENTRYPOINT IN TABLE
1511  077A CD0000               CALL    READID          ; READ FIRST SECTOR AND NCR FORMAT ID
1512  077D C2AF07               JNZ     FIERR
1513  0780 E1                   POP     H               ; RESTORE ENTRYPOINT TO TABLE
1514  0781 E5           EXTINI: PUSH    H               ; AND SAVE AGAIN
1515  0782 77                   MOV     M,A             ; STORE TYPE IN TABLE
1516  0783 3A0000               LDA     HSTDSK
1517  0786 2199FE               LXI     H,DPB0          ; LOAD STARTING ADDRESS OF FIRST DPB TABLE
1518  0789 110F00               LXI     D,DPB1-DPB0     ; LOAD LENGTH OF TABLE
1519  078C 3C                   INR     A
1520  078D 3D           MODLOP: DCR     A               ; COMPUTE STARTING ADDRESS OF DPB TABLE
1521  078E CA9507               JZ      MODLOE          ; FOR DRIVE DINO
1522  0791 19                   DAD     D
1523  0792 C38D07               JMP     MODLOP
1524  0795 EB           MODLOE: XCHG                    ; DE = STARTING ADDRESS OF DPBx TABLE
```

```
                        043    (MBIOS)

1525   0796 E1                  POP     H               ; RESTORE TYPADDRESS
1526   0797 4E                  MOV     C,M             ; DISKTYPE IN C
1527   0798 0600                MVI     B,0             ; EXPAND TYPE NO.
1528   079A 21C107              LXI     H,DSKSPT        ; FIRST PARAMETER TO BE MOVED
1529   079D 09                  DAD     B               ; TYPEDEPENDANT
1530   079E 010400              LXI     B,DSKBLM-DSKBSH ; WIDTH OF TYPE PARAMETER TABLE
1531   07A1 3E0F                MVI     A,DPB1-DPB0     ; LENGTH OF DPBx TABLES
1532   07A3 F5        MOLOOP:   PUSH    PSW             ; SETUP DBPx TABLE  SAVE BYTECOUNTER
1533   07A4 7E                  MOV     A,M             ; GET VALUE
1534   07A5 12                  STAX    D               ; AND STORE IT
1535   07A6 13                  INX     D               ; NEXT PARAMETER IN DBPx TABLE
1536   07A7 09                  DAD     B               ; NEXT PARAMETER IN TYPE PARAMETER TABLE
1537   07A8 F1                  POP     PSW             ; RSTORE COUNTER
1538   07A9 3D                  DCR     A               ; DECREMENT LOOP COUNTER
1539   07AA C2A307              JNZ     MOLOOP          ; LOOP UNTIL ALL PARAMETERS TRANSFERED
1540                   ;
1541   07AD AF                  XRA     A               ; ALL O.K.
1542   07AE C9                  RET
1543
1544                   FIERR:
1545   07AF E1                  POP     H               ;RESTORE TYPEPOINTER
1546   07B0 3E80                MVI     A,80H           ; ERROR NO TYPE SELECTED
1547   07B2 77                  MOV     M,A
1548   07B3 B7                  ORA     A               ; SET FLAGS
1549   07B4 C9                  RET
1550
1551
1552                   PAGE



                        044    (MBIOS)

1553
1554
1555                   TYPDEF 0,1,8,0,2048,128,128,3,80,256,1,0,0    ; NON NCR TYP (DS DD FOR INIT)
1556   0000+=          XLT0    EQU     0
1557                   TYPDEF 1,1,8,0,2048,128,128,3,40,512,0,0,0,0  ; NCR SS DD  1.4 COMP.
1558   0000+=          XLT1    EQU     0
1559                   TYPDEF 2,1,8,0,2048,128,128,3,80,512,1,0,0    ; NCR DS DD
1560   0000+=          XLT2    EQU     0
1561                   TYPDEF 3,1,17,0,8192,512,0,0,610,512,1,0,0    ; SMB-HARD DISK
1562   0000+=          XLT3    EQU     0
1563                   PAGE
```

```
1564
1565
1566                    TYPTAB:
1567                    ;*****************************************
1568                    ;*                                       *
1569                    ;*  Typ:  0    1    2    3               *
1570                    ;*---------------------------------------*
1571  0785 09080909     dskSID: db SIB0, SIB1, SIB2, SIB3 ;SPECIAL BYTE
1572  0789 01020202     dsksic: db sic0, sic1, sic2, sic3 ;Sektorlänge codiert
1573  078D 01030303     dksmsk: db msk0, msk1, msk2, msk3 ;Sektormask für deblock
1574  07C1 10202044     dkspt: db spt0, spt1, spt2, spt3 ;CPM Sektoren pro Track
1575  07C5 00000000     dksph: db sph0, sph1, sph2, sph3 ;high byte
1576  07C9 04040406     dskbsh: db bsh0, bsh1, bsh2, bsh3 ;block shift bsh
1577  07CD 0F0F0F3F     dskblm: db blm0, blm1, blm2, blm3 ;block mask  blm
1578  07D1 01000103     dskext: db exm0, exm1, exm2, exm3 ;extnt mask
1579  07D5 4C499987     dskdsl: db dsl0, dsl1, dsl2, dsl3 ;Disksize low in blocks
1580  07D9 00000002     dskdsh: db dsh0, dsh1, dsh2, dsh3 ;Disksize High
1581  07DD 7F7F7FFF     dskmdl: db mdl0, mdl1, mdl2, mdl3 ;maxdir low
1582  07E1 00000001     dskmdh: db mdh0, mdh1, mdh2, mdh3 ;maxdir high
1583  07E5 C0C0C0C0     dskal0: db al00, al01, al02, al03 ;alloc0
1584  07E9 00000000     dskal1: db al10, al11, al12, al13 ;alloc1
1585  07ED 20202000     dskcsl: db csl0, csl1, csl2, csl3 ;check size low
1586  07F1 00000000     dskcsh: db csh0, csh1, csh2, csh3 ;check size high
1587  07F5 03030300     dskofl: db ofl0, ofl1, ofl2, ofl3 ;track offset low
1588  07F9 00000000     dskofh: db ofh0, ofh1, ofh2, ofh3 ;track offset high
1589  07FD 00000000     dskdbl: db DBL0, DBL1, DBL2, DBL3 ;SECTORTRANSLATE YES/NO
1590  0801 10101040     dskcnt: db  bl0,  bl1,  bl2,  bl3 ;Blocksize/128
1591  0805 50285062     DSKTRK: DB TRL0, TRL1, TRL2, TRL3 ;NO. OF TRACKS OF DISC LOW BYTE
1592  0809 00000002     DSKTRH: DB TRH0, TRH1, TRH2, TRH3 ;NO. OF TRACKS HIGH BYTE
1593  080D 08080811     DSKMSC: DB MSC0, MSC1, MSC2, MSC3 ;MAXIMUM SECTORNO.
1594                    PAGE
```

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                        046    (NBIOS)

1595
1596
1597   0020 =       LEN     EQU     32              ; LENGTH OF XLT TABLE
1598   0002 =       VER     EQU     2               ; VERSION OF DEBLOCKING
1599   0220 =       VERLEN  EQU     (VER*256)+LEN   ; IDENTIFICATION WORD
1600                ;
1601   0811         XLT:    DS      LEN
1602                ;
1603   0831 FF      DSKTYP: DB      0FFH            ;DISKTYP TABLE
1604   0832 FF              DB      0FFH            ;TYPE INITIALLY NOT SELECTED (FF)
1605   0833 FF              DB      0FFH
1606   0834 FF              DB      0FFH
1607   0835 FF              DB      0FFH
1608   0836 FF              DB      0FFH
1609   0837 FF              DB      0FFH
1610   0838 FF              DB      0FFH
1611   0839 FF              DB      0FFH
1612   083A FF              DB      0FFH
1613                ;
1614                ;
1615                ;
1616                ;
1617                ;
1618                ;
1619                ;
1620                ;
1621                ;
1622                ;
1623                ;                       DFC2
1624                DISPERO:
1625   083B CD0000          CALL    WRCUPO  ;SET CURSOR
1626   083E 7E      DISPER1:MOV     A,M
1627   083F FE24            CPI     '$'
1628   0841 C8              RZ              ; RETURN IF END OF MESSAGE
1629   0842 4F              MOV     C,A
1630   0843 E5              PUSH    H
1631   0844 CD0000          CALL    CONOUT          ; DISPLAY CHARACTER
1632   0847 E1              POP     H
1633   0848 23              INX     H
1634   0849 C33E08          JMP     DISPER1         ; NEXT CHARACTER
1635
1636                PAGE
```

```
1637
1638                    ;*****************************************************************
1639                    ;*                                                               *
1640                    ;*      OFST    ADD [A] TO [HL] RESULT IN [HL]                   *
1641                    ;*                                                               *
1642                    ;*****************************************************************
1643
1644  084C 85           OFST:   ADD     L
1645  084D 6F                   MOV     L,A
1646  084E 00                   RNC
1647  084F 24                   INR     H
1648  0850 C9                   RET
1649
1650
1651                    ;*****************************************************************
1652                    ;*                                                               *
1653                    ;*     SELTYP      RETURNS PARAMETERS FOR XCHG UTILITY           *
1654                    ;*                                                               *
1655                    ;*****************************************************************
1656
1657  0851 3E04         SELTYP: MVI     A,DSKBLM-DSKBSH ; LOAD WIDTH OF TYP-TABLE
1658  0853 012002               LXI     B,VERLEN        ; LOAD VERSIONNO. AND TABLELENGTH
1659  0856 111108               LXI     D,XLT           ; LOAD STARTING ADDRESS OF XLT-TABLE
1660  0859 21B507               LXI     H,TYPTAB        ; LOAD STARTING ADDRESS OF TYP-TABLE
1661  085C C9                   RET
1662
1663                    ;*****************************************************************
1664                    ;*                                                               *
1665                    ;*  CMPERE     COMPARE STRING AT [DE] WITH STRING AT [HL]        *
1666                    ;*             B BYTES                                           *
1667                    ;*                                                               *
1668                    ;*****************************************************************
1669
1670
1671  085D 1A           CMPRE:  LDAX    D               ; COMPARES (HL) WITH (DE)  B BYTES
1672  085E BE                   CMP     M               ; RETURNS ZERO IF EQUAL OTHERWISE NON ZERO
1673  085F C0                   RNZ                     ; RETURN IF NOT EQUAL
1674  0860 23                   INX     H
1675  0861 13                   INX     D
1676  0862 05                   DCR     B
1677  0863 C8                   RZ                      ; RETURN IF EQUAL
1678  0864 C35D08               JMP     CMPRE
1679
1680
1681                            PAGE
```

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                        048    (NBIOS)

1682
1683
1684                    ;*****************************************************************
1685                    ;*                                                               *
1686                    ;*      CKSEL   CHECK IF DISK SELECTED                           *
1687                    ;*                                                               *
1688                    ;*****************************************************************
1689
1690                    CKSEL:
1691    0867 0600               MVI     B,0             ; DISKNO IN C  EXPAND TO 16 BIT
1692    0869 213108             LXI     H,DSKTYP        ; BASEADDRESS OF DISK TYPE TABLE
1693    086C 09                 DAD     B               ; COMPUTE ENTRYPOINT FOR DRIVE
1694    086D 7E                 MOV     A,M             ; GET TYPE
1695    086E E680               ANI     80H             ; IF BIT 8 IS SET  DRIVE IS NOT INITIALIZED
1696    0870 C9                 RET
1697    0871            END
```

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                    050    (NBIOS)

CSV1            F831   177#  178  1041
CSV2            0000   179#  1045
CSV3            0000   181#  1049
CSV4            0000   183#  1053
CSV5            0000   185#  1057
CSV6            0000   187#  1061
CSV7            0000   189#  1065
CSV8            0000   191#  1069
CSV9            0000   193#  1073
CURCOL          0000    80   412
CURDISK         0004   150#  291   330   505
CWRITE          0000    80   458
DANSK           035C   916#
DCOMD           0051   129#
DHOME           0000    80   459   499
DIRBUF          FA00   173#  174   1036  1040  1044  1048  1052  1056  1060  1064
                       1068  1072
DISFD           0007   147#
DISKIO          0000    84   1435
DISPER0         083B   235   1624#
DISPER1         083E   1626# 1634
DISPERR         0039   101   103   234#  414
DMAADR          0000    81   564   1304
DMACOM          0028   140#
DMAMB           002A   143#
DMAMO           0028   142#
DMAREAD         0008   145#
DMASET          0000    79   374   453
DMAST           0028   141#
DMAWRT          0004   144#
DNBRR           0001   116#
DNBRS           0000   117#
DPB0            FE99   195#  196   1036  1517  1518  1531
DPB1            FEA8   196#  197   1040  1518  1531
DPB2            FEB7   197#  198   1044
DPB3            FEC6   198#  199   1048
DPB4            FED5   199#  200   1052
DPB5            FEE4   200#  201   1056
DPB6            FEF3   201#  202   1060
DPB7            FF02   202#  203   1064
DPB8            FF11   203#  204   1068
DPB9            FF20   204#  1072
DPBASE          0504   485   1030# 1033#
DPE0            0504   1034#
DPE1            0514   1038#
DPE2            0524   1042#
DPE3            0534   1046#
DPE4            0544   1050#
DPE5            0554   1054#
DPE6            0564   1058#
DPE7            0574   1062#
DPE8            0584   1066#
DPE9            0594   1070#
DSKAL0          07E5   1583#
DSKAL1          07E9   1584#
DSKBLM          07CD   1530  1577# 1657
```

052 (NBIOS)

```
FATERRM         0488   103  1019#
FDCRA           0051   131#
FDINIT          076F  1393  1505#
FF              000C   154#
FFILLER         0055   872#  873
FIERR           07AF  1512  1544#
FILHST          0669  1245  1266#
FILLER          0005   717#  719
FIXINIT         0762   104   498  1484#
FLUSH           06F0   105  1366# 1389
FNERRM          049F   101  1020#
FNTBLNO         0315   100   874#
FORMATT         0000    80   451
FRANCE          0321   901#
FREAD           0000    85   461
FUNTBL          0215   100   723   769#  872
FWRITE          0000    85   462
FWVER           0FF7   118#
GERMANY         0336   906#
GETDPH          016C   480#  496   500
G01             00A3   335   337#
HOME            01A0   223   518#
HOMED           01AA   521   523#
HRDDSK          017D   476   490#
HSTACT          0000    83   522  1241  1374
HSTBLKD         0004  1104# 1105  1106
HSTBUF          F600   172#  173  1301  1433
HSTDSK          0000    83  1248  1269  1282  1324  1418  1484  1505  1516
HSTSEC          0000    83   386  1256  1273  1424  1432  1437
HSTSIZD         0200   380  1102# 1104
HSTSPTD         0008  1103# 1105
HSTTRK          0000    83  1271
HSTWRT          0000    83   519  1262  1278  1312  1356  1366  1375
INITBDOS        003F   246#  321
INPBFF          0002   165#
IOBSET          0208   102   731#
IOBYTE          0003   149#
IOERRM          0473   103  1018#
ITALY           037C   925#
KBDAT           0001   168#
KBELL           0041   163#
KCOUNT          0041   164#
KEYBASE         0040   159#  160   161   162   163   164
KEYTBL          03EE   100   725   967#
KSPAIN          036F   921#
LEN             0020  1597# 1599  1601
LEN1            0008   771   773#
LEN10           0009   816   818#
LEN11           000C   821   823#
LEN12           0004   826   828#
LEN13           0004   831   833#
LEN14           0008   836   838#
LEN15           0009   841   843#
LEN16           0007   846   848#
LEN17           0007   852   854#
LEN18           0007   856   858#
```

```
                        053    (MBIOS)

LEN19           0007    861    863#
LEN2            0008    773    778#
LEN20           0004    866    868#
LEN3            0008    781    783#
LEN4            0011    786    788#
LEN5            0008    791    793#
LEN6            0008    796    798#
LEN7            0008    802    804#
LEN8            0011    806    808#
LEN9            000A    811    813#
LF              000A    152#
LGDAT           0000    167#
LINBUF          FDF9    194#   195
LIST            0000     77    220
LISTST          0000     77    230
LOAD1           00E1    377#   388
LOAD2           00FF    385    390#
LOADA           00B2    356#   364
LOADB           00C6    360    366#
LOADSYS         00A9    289    306    351#   422
LVAR0           0316    892#   894
LVAR1           0319    896#   898
LVAR10          03A8    938#   941
LVAR11          0387    943#   946
LVAR12          03C8    948#   951
LVAR13          03D9    953#   956
LVAR2           0320    900#   903
LVAR3           0335    905#   908
LVAR4           0348    910#   913
LVAR5           0358    915#   918
LVAR6           036E    920#   922
LVAR7           0378    924#   927
LVAR8           0392    929#   932
LVAR9           03A7    934#   936
M1RS232         0210    104    743#
M2RS232         0211    104    745#
MATCH           0686   1258   1280#
MCRTTBL         0204    724#
MFNTBL          0202    723#
MKEYTBL         0206    725#
MMAREA          0200    722#
MMESS           0208    726#
MODEFL          020E    333    735#
MODLOE          0795   1521   1524#
MODLOP          078D   1520#  1523
MOLOOP          07A3   1532#  1539
MOTOROFF        0001    132#
MOTORON         0014    137#
MOUNT           0706    478   1386#
MOVE            01E4    100    641#
MOVEL           01EA    101    658#
MUL1            01CB    611#   620
MUL2            01D0    612    614#
MUL3            01D9    615    617    619#
MULT            01C2    101    605#
MUSICC          0006    170#
```

```
                    054    (NBIOS)

NBRFLEX         020A   105   474   730#
NCRDMV          0070   292   318#
NCRVER          0004   115#
NCRVERH         0000   114#
NOMATCH         0662  1252  1260#
NOOSDSK         0108   368   402#
NOOSERM         041E   403  1014#
NOOVF           0613  1194  1202#
NOTRDYM         0436   103  1015#
NRDYRX          0447   102  1016#
NUMHDSK         0214   491   753#
OFST            084C   100   442   486  1428  1644#
OUTPBFF         0001   166#
PMADR           0000    79   379   382  1434
PORTUG          03C9   949#
PUNCH           0000    77   221
PVRS232         0213   104   751#
RAMSEL          0010   133#
RDKEY           0040   161#
RDTRAK          0000    79   393   452
READ            05A4   228  1125#
READER          0000    77   222
READHST         071A  1276  1414#
READID          0000    82  1511
READOP          0000    81  1129  1144  1306
READSEC1        0000    78   358
RELEASE         0004   113#
RELEASEH        0000   112#
RESET           0000    78   269   288   305
RETRYC          020C   102   354   732#
ROMSEL          0011   134#
RSFLAG          0000    83  1130  1205  1213  1274
RSKEY           0041   162#
RSTBDOS         0052   254   268#  450
RSTC            020D   102   733#
RWEND           06EE  1350  1359#
RWM1            06D7  1331  1343#
RWM2            06CE  1335# 1342
RWMOVE          0686  1308  1315#
RWOPER          0622  1133  1206  1223#
SAFRICA         03B8   944#
SAVESEC         0000    84  1425  1436
SECMSKD         0003  1106#
SECSET          0000    79   372   456
SECSHFD         0002  1107#
SECTRAN         0180   231   577#
SEKDSK          0000    81   477   480   487   494  1151  1157  1177  1227  1249
                      1268  1391
SEKHST          0000    81  1238  1255  1272
SEKSEC          0000    81   550  1232  1286
SEKTRK          0000    81   536  1270
SELCTER         0198   479   493   502#
SELDSK          0158   224   472#
SELTYP          0851   233  1657#
SETDMA          0187   227   561#
SETSEC          0181   226   547#
```

```
                        055    (NBIOS)

SETTC           0012   135#
SETTRK          014B   229   533#
SHIFT           0637  1234# 1237
SHIFTE          0639  1233  1236#
SPAREA          020A   722   727#
SPECFUN         0134   232   438#
SPECTBL         0141   441   449#
STBIOS          0000   102   215#  717
SUBHLDE         01F0   101   675#
SWEDEN          0349   911#
SWISS12         0393   930#
SYSSTA          0013   136#
TOF             000C   155#
TRKSET          0000    79   370   392   455
TYPTAB          0785  1566# 1660
UK              031A   897#
UNACNT          0000    82  1127  1156  1168  1174  1211  1373
UNADSK          0008    82  1158  1176  1187
UNASEC          0000    82
UNATRK          0000    82  1198  1200
US              0317   893#
VAR0L           0003   892   894#
VAR10L          000F   938   941#
VAR11L          0011   943   946#
VAR12L          0011   948   951#
VAR13L          0015   953   956#
VAR1L           0007   896   898#
VAR2L           0015   900   903#
VAR3L           0013   905   908#
VAR4L           0013   910   913#
VAR5L           0013   915   918#
VAR6L           000D   920   922#
VAR7L           0017   924   927#
VAR8L           0015   929   932#
VAR9L           0001   934   936#
VER             0002  1598# 1599
VERLEN          0220  1599# 1658
WBOOT           006F   216   303#
WBOTE           0003   104   216#
WDKEY           0040   160#
WINIT           0000    78   307
WRALL           0000  1112#
WRCUPO          0000    77  1625
WRDIR           0001  1113# 1348
WRITE           0588   229  1141#
WRITEHST        0718  1264  1357  1370  1411#
WRPRCTM         045A   103  1017#
WRTYPE          0000    81  1132  1146  1347
WRUAL           0002  1114# 1131  1147
XLT             0811  1427  1601# 1659
XLT0            0000  1556#
XLT1            0000  1558#
XLT2            0000  1560#
XLT3            0000  1562#
YUGOSL          030A   954#
```

```
                        =003    (OBIOS)

64
65                      ;*****************************************************************
66                      ;*****************************************************************
67                      ;********                                               ********
68                      ;********      EXTERNAL DEFINITIONS                     ********
69                      ;********                                               ********
70                      ;*****************************************************************
71                      ;*****************************************************************
72                      ;
73                      ;
74                      ;
75                      EXTRN   RSTC,RETRYC,FIXINIT,FLUSH,CMPRE,DSKTYP
76                      EXTRN   MOVE,CLOSE,CURCOL,TMPCOL,DISPERR
77                      EXTRN   NOTRDYM,WRPRCTM,FATERRM,IDERRM,NRDYRX
78                      EXTRN   CONIN,CLRLIN,WBOTE,DSKGET,DSKTRK,DSKSID,DSKSLC,DSKMSC
79                      EXTRN   WINDRE,WINDFM,WINDRW,NORFLEX
80                      ;
81
82                              PAGE



                         004    (OBIOS)

83
84                      ;*****************************************************************
85                      ;*****************************************************************
86                      ;********                                               ********
87                      ;********      ENTRY DEFINITIONS                        ********
88                      ;********                                               ********
89                      ;*****************************************************************
90                      ;*****************************************************************
91                      ;
92                      ;
93                      ;
94                      PUBLIC  PMAADR,ERRBUF,BTRECS,SAVESEC,DTRKSET
95                      PUBLIC  DMAADR,READOP,WRTYPE,ERFLAG
96                      PUBLIC  SEKDSK,SEKTRK,SEKSEC,SEKHST
97                      PUBLIC  UNACNT,UNADSK,UNATRK,UNASEC
98                      PUBLIC  RSFLAG,HSTACT,HSTDSK,HSTWRT,HSTSEC,HSTTRK,DSKCMD
99                      PUBLIC  RESET,DSKSET,READSEC1,DSKERR,CHECKOS
100                     PUBLIC  TRKSET,SECSET,DMASET,CREAD,RDTRAK,FORMATT,CWRITE
101                     PUBLIC  DHOME,READID,DISKIO,COMBLO,ERRBUF
102                     PUBLIC  FREAD,FWRITE
103                     PAGE
```

```
104
105             ;++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
106             ;+*****************************************************************+
107             ;+*                                                               *+
108             ;+*       PHYSICAL ROUTINES FOR MCR DM5  FLEX CONTROLLER          *+
109             ;+*                                                               *+
110             ;+*****************************************************************+
111             ;++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
112             DISKCEQU
113     +       ;*****************************************************************
114     +       ;*                                                               *
115     +       ;*              DISK CONTROLLER EQUATES 30.11.82 11:56 PH        *
116     +       ;*                                                               *
117     +       ;*****************************************************************
118     +
119     +
120   0051+=    DCOMD   EQU     00051H          ; DISK COMMAND PORT
121   0050+=    DSTAT   EQU     00050H          ; DISK STATUS PORT
122   0051+=    FDCRA   EQU     00051H          ; READ DATA FROM FDC
123     +       ;
124   0001+=    MOTOROFF        EQU     01H     ; MOTOR OFF INDICATOR (SYSSTA)
125     +       ;
126     +       ;
127   0010+=    RAMSEL  EQU     00010H          ; RAM SELECT
128   0011+=    ROMSEL  EQU     00011H          ; ROM SELECT
129   0012+=    SETTC   EQU     00012H          ; SET TC
130   0013+=    SYSSTA  EQU     00013H          ; SYSTEM STATUS PORT
131   0014+=    MOTORON EQU     00014H          ; MOTOR ON
132   0026+=    COAD    EQU     00026H          ; FDC DMA CHANNEL
133   0027+=    COTC    EQU     00027H          ; FDC DMA CHANNEL
134   0028+=    DMACOM  EQU     00028H          ; DMA COMMAND
135   0028+=    DMAST   EQU     00028H          ; READ DMA STATUS
136   002B+=    DMAMC   EQU     0002BH
137   002A+=    DMAMB   EQU     0002AH
138     +
139   0004+=    DMAWRT  EQU     004H            ; DMA WRITE COMMAND
140   0008+=    DMAREAD EQU     008H            ; DMA READ COMMAND
141     +
142   0003+=    ENFD    EQU     003H            ; ENABLE FDC CHANNEL (CH3)
143   0007+=    DISFD   EQU     007H            ; DISABLE FDC CHANNEL (CH3)
144     +
145     +
146     +               PAGE
```

```
                    006    (OBIOS)

147       +
148       +                 ENDM
149                 DISKBFF
150       +
151       +         ;*****************************************************************
152       +         ;*                                                               *
153       +         ;*              DISK BUFFER MACRO 11.03.83 17.15 PH              *
154       +         ;*                                                               *
155       +         ;*****************************************************************
156       +
157       +
158   F600+=        HSTBUF  EQU     0F600H          ;LENGTH 400H
159   FA00+=        DIRBUF  EQU     HSTBUF+400H     ;LENGTH 128
160   FA80+=        ALV0    EQU     DIRBUF+128      ;LENGTH 32
161   FAA0+=        CSV0    EQU     ALV0+32         ;LENGTH 64
162   FAE0+=        ALV1    EQU     CSV0+64         ;LENGTH 81
163   FB31+=        CSV1    EQU     ALV1+81         ;LENGTH 64
164   FB71+=        ALV2    EQU     CSV1+64         ;LENGTH 81
165   0000+=        CSV2    EQU     0               ;NOT USED FOR HARD DISK
166   FBC2+=        ALV3    EQU     ALV2+81         ;LENGTH 81
167   0000+=        CSV3    EQU     0               ;NOT USED FOR HARD DISK
168   FC13+=        ALV4    EQU     ALV3+81         ;LENGTH 81
169   0000+=        CSV4    EQU     0               ;NOT USED FOR HARD DISK
170   FC64+=        ALV5    EQU     ALV4+81         ;LENGTH 81
171   0000+=        CSV5    EQU     0               ;NOT USED FOR HARD DISK
172   FCB5+=        ALV6    EQU     ALV5+81         ;LENGTH 81
173   0000+=        CSV6    EQU     0               ;NOT USED FOR HARD DISK
174   FD06+=        ALV7    EQU     ALV6+81         ;LENGTH 81
175   0000+=        CSV7    EQU     0               ;NOT USED FOR HARD DISK
176   FD57+=        ALV8    EQU     ALV7+81         ;LENGTH 81
177   0000+=        CSV8    EQU     0               ;NOT USED FOR HARD DISK
178   FDA8+=        ALV9    EQU     ALV8+81         ;LENGTH 81
179   0000+=        CSV9    EQU     0               ;NOT USED FOR HARD DISK
180   FDF9+=        LINBUF  EQU     ALV9+81         ;LENGTH 160
181   FE99+=        DPB0    EQU     LINBUF+160      ;LENGTH 15
182   FEA8+=        DPB1    EQU     DPB0+15         ;LENGTH 15
183   FEB7+=        DPB2    EQU     DPB1+15         ;LENGTH 15
184   FEC6+=        DPB3    EQU     DPB2+15         ;LENGTH 15
185   FED5+=        DPB4    EQU     DPB3+15         ;LENGTH 15
186   FEE4+=        DPB5    EQU     DPB4+15         ;LENGTH 15
187   FEF3+=        DPB6    EQU     DPB5+15         ;LENGTH 15
188   FF02+=        DPB7    EQU     DPB6+15         ;LENGTH 15
189   FF11+=        DPB8    EQU     DPB7+15         ;LENGTH 15
190   FF20+=        DPB9    EQU     DPB8+15         ;LENGTH 15
191       +           ENDM
```

```
192                     CNTLEQU
193       +             ;*****************************************************************
194       +             ;*                                                               *
195       +             ;*      CONTROL CHARACTER EQUATES 27/10/82 10:22 WF              *
196       +             ;*                                                               *
197       +             ;*****************************************************************
198       +
199       +
200   0003+=            IOBYTE  EQU     3               ; I/O BYTE
201   0004+=            CURDISK EQU     4               ; CURRENT DISK NUMBER
202   000D+=            CR      EQU     0DH             ; CARRIGE RETURN
203   000A+=            LF      EQU     0AH             ; LINE FEED
204   0008+=            BS      EQU     08H             ; BACK SPACE
205   000C+=            FF      EQU     0CH             ; FORM FEED
206   000C+=            TOF     EQU     0CH             ; TOP OF FORM
207   0018+=            ESC     EQU     18H             ; ESCAPE
208   001A+=            CLRSCN  EQU     01AH            ; CLEAR SCREEN
209       +                     PAGE
```

```
                    008    (QBIOS)

210       +
211       +                 ENDM
212                 ;*****************************************************************
213                 ;*                DISK DEBLOCKING MACROS                         *
214                 ;*****************************************************************
215
216                 ;       UTILITY MACRO TO COMPUTE SECTOR MASK
217
218                 SMASK   MACRO   HBLK            ;COMPUTE LOG2(HBLK) RETURN @X
219                 @Y      SET     HBLK
220                 @X      SET     0
221                         REPT    8
222                         IF      @Y = 1
223                         EXITM
224                         ENDIF
225                 ;       @Y IS NOT 1, SHIFT RIGHT ONE POSITION
226                 @Y      SET     @Y SHR 1
227                 @X      SET     @X + 1
228                         ENDM
229                         ENDM
230                 HOSTDEQU
231       +         ;*****************************************************************
232       +         ;*                                                               *
233       +         ;*     CP/M TO HOST DISK CONSTANTS 27/10/82 10:23 WF             *
234       +         ;*                                                               *
235       +         ;*****************************************************************
236       +
237   0800+=        BLKSIZ  EQU     2048            ;CP/M ALLOCATION SIZE
238       +
239   0200+=        HSTSIZD EQU     512             ;HOST DISK SECTOR SIZE
240   0008+=        HSTSPTD EQU     08              ;HOST DISK SECTORS/TRK
241   0004+=        HSTBLKD EQU     HSTSIZD/128     ;CP/M SECTS/HOST BUFF
242   0020+=        CPMSPTD EQU     HSTBLKD * HSTSPTD       ;CP/M SECTORS/TRACK
243   0003+=        SECMSKD EQU     HSTBLKD-1       ;SECTOR MASK
244       +                 SMASK   HSTBLKD         ;COMPUTE SECTOR MASK
245   0004+=        @Y      SET     HSTBLKD
246   0000+=        @X      SET     0
247       +                 REPT    8
248       +                 IF      @Y = 1
249       +                 EXITM
250       +                 ENDIF
251       +         ;       @Y IS NOT 1, SHIFT RIGHT ONE POSITION
252       +         @Y      SET     @Y SHR 1
253       +         @X      SET     @X + 1
254       +                 ENDM
255       +                 IF      @Y = 1
256       +                 EXITM
257       +                 ENDIF
258       +         ;       @Y IS NOT 1, SHIFT RIGHT ONE POSITION
259   0002+=        @Y      SET     @Y SHR 1
260   0001+=        @X      SET     @X + 1
261       +                 IF      @Y = 1
262       +                 EXITM
263       +                 ENDIF
264       +         ;       @Y IS NOT 1, SHIFT RIGHT ONE POSITION
265   0001+=        @Y      SET     @Y SHR 1
```

```
                        009    (OBIOS)

266   0002+;        @X      SET     @X + 1
267     +                   IF      @Y = 1
268     +                   EXITM
269     +                   ENDM
270   0002+=        SECSHFD EQU     @X              ;LOG2(HSTBLK)
271     +
272     +                   ENDM
273                 DISKCOEQ
274     +           ;*****************************************************************
275     +           ;*                                                               *
276     +           ;*              DISK CONTROL BITS 24.01.83 12:00 PM              *
277     +           ;*                                                               *
278     +           ;*****************************************************************
279     +
280     +
281   0004+=            SIDE1   EQU     04H             ; SIDE SELECT BIT
282   0000+=            UNITLO  EQU     00H             ; LO UNIT BIT
283   0002+=            UNITHI  EQU     02H             ; HI UNIT BIT
284   0008+=            FDCEOT EQU     08              ; MAX NUMBER OF SECTORS / TRACK
285   0008+=            FDCIN   EQU     08H             ; FDC INT BIT IN MAIN STATUS
286   0002+=            DDIND   EQU     02H             ; DENSITY INDICATOR (2-512 BYTES)
287   0040+=            DDEN    EQU     040H            ; DOUBLE DENSITY BIT
288   0018+=            GPL     EQU     1BH             ; GAP LENGTH
289     +
290     +                   ENDM
291                 DISKCKEQ
292     +           ;*****************************************************************
293     +           ;*                                                               *
294     +           ;*              DISK CONTROLLER COMMANDS 27/10/82 10:26 WF       *
295     +           ;*****************************************************************
296     +
297     +
298   0002+=            READTRK EQU     02H             ; READ A TRACK
299   0005+=            WRITDAT EQU     05H             ; WRITE DATA COMMAND
300   0006+=            READDAT EQU     06H             ; READ DATA COMMAND
301   0007+=            RESTORE EQU     07H             ; RESTORE COMMAND
302   0008+=            FDCSIS EQU      08H             ; SENSE INTERRUPT STATUS
303   000A+=            IDREAD EQU      0AH             ; READ ID
304   000D+=            WRITFMT EQU     0DH             ; FORMAT A TRACK
305   000F+=            SEEKTRK EQU     0FH             ; SEEK A TRACK
306     +
307     +                       PAGE
```

```
                    010    (OBIOS)

308       +
309       +                 ENDM
310                 ;*****************************************************************
311                 ;*                                                               *
312                 ;*      DISKIO          READ / WRITE SECTOR                      *
313                 ;*                                                               *
314                 ;*****************************************************************
315
316                 DISKIO:
317   0000 3A0000               LDA     RSTC            ; GET RESTORE COUNT
318   0003 4F                   MOV     C,A             ;   --> C
319                 DIO1:
320   0004 3A0000               LDA     RETRYC          ; GET RETRY COUNT
321   0007 47                   MOV     B,A             ;   --> B
322                 DIO2:
323   0008 CDD500               CALL    DDIO            ; "READ"
324   0008 C8                   RZ                      ; RETURN IF NO ERROR OCCURED
325   000C CD9003               CALL    DSKERR          ; DETECT DISK ERRORS
326   000F 05                   DCR     B               ; RETRIES - 1
327   0010 C20800               JNZ     DIO2            ; RETRY
328
329   0013 0D                   DCR     C               ; RESTORE - 1
330   0014 CA1D00               JZ      RWERR           ; REPORT ERROR OR OVERRIDE
331   0017 CDCD01               CALL    RECAL           ; "RECALIBRATE"
332   001A C30400               JMP     DIO1            ; RETRY
333
334
335                 RWERR:
336   001D 3EFF                 MVI     A,0FFH          ; ERROR CODE
337   001F 329904               STA     ERFLAG
338   0022 B7                   ORA     A
339   0023 C9                   RET
340
341                 PAGE
```

```
342
343                     ;*****************************************************************
344                     ;*                                                               *
345                     ;*      CWRITE          WRITE SECTOR                             *
346                     ;*                                                               *
347                     ;*****************************************************************
348
349                     CWRITE:
350   0024 AF                   XRA     A               ; CODE FOR WRITE SECTOR
351   0025 328D04               STA     DSKCMD          ; SAVE IT
352   0028 C30000               JMP     DISKIO          ;
353
354                     ;*****************************************************************
355                     ;*                                                               *
356                     ;*      CREAD           READ SECTOR                              *
357                     ;*                                                               *
358                     ;*****************************************************************
359
360   002B 3E01         CREAD:  MVI     A,01H           ; CODE FOR READ SECTOR
361   002D 328D04               STA     DSKCMD          ; SAVE COMMAND
362   0030 C30000               JMP     DISKIO          ;
363
364
365                     ;*****************************************************************
366                     ;*                                                               *
367                     ;*      FWRITE  WRITE SECTOR RETURN ERROR                        *
368                     ;*                                                               *
369                     ;*****************************************************************
370
371   0033 AF           FWRITE: XRA     A
372   0034 328D04               STA     DSKCMD          ; SAVE WRITE COMMAND
373   0037 C30500               JMP     DOIO
374
375
376                     ;*****************************************************************
377                     ;*                                                               *
378                     ;*      FREAD   READ SECTOR RETURN EKROR                         *
379                     ;*                                                               *
380                     ;*****************************************************************
381
382   003A 3E01         FREAD:  MVI     A,01H
383   003C 328D04               STA     DSKCMD          ; SAVE READ COMMAND
384   003F C30500               JMP     DOIO
385
386                     PAGE
```

```
                    012    (OBIOS)

387
388                 ;*********************************************************************
389                 ;*                                                                   *
390                 ;*      FORMATT WRITE OUT A TRACK                                    *
391                 ;*                    [D]  PATTERN                                   *
392                 ;*                                                                   *
393                 ;*********************************************************************
394
395
396
397                 FORMATT:
398   0042 0E00             MVI     C,WRITFMT       ; FIRST PUT IN THE WRITE TRACK COMMAND
399   0044 3A6F04           LDA     HSTDSK
400   0047 210000           LXI     H,NBRFLEX
401   004A BE               CMP     M
402   004B D20000           JNC     WINDFM
403   004E D5               PUSH    D               ; SAVE PATTERN
404   004F CD5501           CALL    SETUPH          ; SET UP FUNCTION AND DRIVE #
405   0052 3602             MVI     M,DDIND         ; DENSITY INDICATOR
406   0054 23               INX     H
407   0055 3608             MVI     M,FDCEOT
408   0057 23               INX     H
409   0058 3650             MVI     M,50H           ; GPL  = IBM FORMAT
410   005A 23               INX     H
411   005B D1               POP     D
412   005C 72               MOV     M,D             ; PATTERN
413   005D CD2E03           CALL    SEEK1           ; SEEK TRACK
414   0060 0608             MVI     B,DMAREAD
415   0062 211F00           LXI     H,HSTSPTD*4-1   ; DMA LENGTH
416   0065 CDAF02           CALL    DMA1            ; INIT DMA
417   0068 0606             MVI     B,6             ; # OF CONTROLL BYTES
418   006A CDCA02           CALL    FDCWAIT           ; SEND BYTES
419   006D C8               RZ                      ;RETURN IF GOOD STATUS
420   006E 010101           LXI     B,0101H         ;NO RETRY
421   0071 CD9003           CALL    DSKERR          ;DETECT DISK ERRORS
422   0074 05               DCR     B               ;
423   0075 C24200           JNZ     FORMATT         ;JUMP IF RETRY
424   0078 C31D00           JMP     RWERR           ;ELSE OVERRIDE
425
426
427                         PAGE
```

```
                        013    (OBIOS)

428
429
430                     ;*****************************************************************
431                     ;*                                                               *
432                     ;*      RDTRAK  READ A TRACK                                     *
433                     ;*                                                               *
434                     ;*****************************************************************
435
436
437
438                     RDTRAK:
439   0078 3E01                 MVI     A,1
440   007A 327204               STA     HSTSEC          ; SET SECTOR   = 1
441   007D 0E46                 MVI     C,046H          ; FIRST PUT IN THE READ TRACK COMMAND
442   007F CDF800               CALL    FDCSET          ; SET FUNCTION AND DRIVE
443   0082 0604                 MVI     B,DMAWRT
444   0084 21FF0F               LXI     H,HSTSIZD*HSTSPTD-1     ; SIZE OF A TRACK -1 = DMA LENGTH
445   0087 CDAF02               CALL    DMA1            ; INITIALIZE DMA
446   008A 0609                 MVI     B,9             ; # OF CONTROLL BYTES
447   008C CDCA02               CALL    FDCWAIT         ; SEND OUT THE COMMAD AND WAIT FOR COMPLETION
448   008F C29900               JNZ     CRDTR1          ;JUMP IF ABNORMAL TERMINATION
449   0092 23                   INX     H               ;ERROR BUFFER + 1 = ST 1
450   0093 7E                   MOV     A,M             ;GET STATUS 1
451   0094 B7                   ORA     A
452   0095 C8                   RZ                      ; RETURN IF GOOD STATUS
453                     CRDTR1:
454   0096 010101               LXI     B,0101H         ;NO RETRY
455   0099 CD9003               CALL    DSKERR          ; DETECT DISK ERRORS
456   009C 05                   DCR     B               ;
457   009D C27B00               JNZ     RDTRAK          ; JUMP IF RETRY
458   00A0 C31D00               JMP     RWERR           ; ELSE OVERRIDE
459
460
461                     PAGE
```

```
                        014    (OBIOS)

462
463                     ;*****************************************************************
464                     ;*                                                               *
465                     ;*      DMASET  SET PHYSICAL DMA ADDRESS                         *
466                     ;*              [DE] - DMA-ADDRESS                               *
467                     ;*                                                               *
468                     ;*****************************************************************
469
470
471
472   00A6 EB       DMASET: XCHG
473   00A7 229104           SHLD    PHAADR          ; SET DMA ADDRESS
474   00AA C9               RET
475
476
477
478                     ;*****************************************************************
479                     ;*                                                               *
480                     ;*      DSKSET  SET PHYSICAL DISK                                *
481                     ;*              [E] - DISK NUMBER                                *
482                     ;*                                                               *
483                     ;*                                                               *
484                     ;*****************************************************************
485
486
487
488   00AB D5       DSKSET: PUSH    D               ; SAVE DISKNO.
489   00AC CD0000           CALL    FLUSH
490   00AF CD0000           CALL    CLOSE
491   00B2 C1               POP     B               ; RESTORE INTO C
492   00B3 79               MOV     A,C
493   00B4 210000           LXI     H,NBRFLEX
494   00B7 BE               CMP     M
495   00B8 D2BE00           JNC     DSKSET1
496   00BB 3E02             MVI     A,2             ; FLEX DISK
497   00BD 21               DB      21H
498   00BE 3E03     DSKSET1: MVI    A,3             ; FIX DISK
499   00C0 CD0000           CALL    FIXINIT         ; INITIALIZE AS DS DD MCR DISK
500   00C3 C9               RET
501
502
503
504                     ;*****************************************************************
505                     ;*                                                               *
506                     ;*      TRKSET  SET PHYSICAL TRACK                               *
507                     ;*              [E] - TRACK NUMBER                               *
508                     ;*                                                               *
509                     ;*****************************************************************
510
511
512
513   00C4 68       TRKSET: MOV     L,E
514   00C5 2600             MVI     H,0
515   00C7 227004           SHLD    HSTTRK          ; SET TRACK
516   00CA C9               RET
517

                        015    (OBIOS)

518
519                      PAGE
```

```
520
521                     ;*****************************************************************
522                     ;*                                                               *
523                     ;*      SECSET  SET PHYSICAL SECTOR                              *
524                     ;*              [E] - SECTOR NUMBER                              *
525                     ;*                                                               *
526                     ;*****************************************************************
527
528
529
530   00CB 78           SECSET: MOV     A,E
531   00CC 327204             STA     HSTSEC          ; SET SECTOR
532   00CF C9                 RET
533
534                     ;*****************************************************************
535                     ;*                                                               *
536                     ;*      PSDRK   SET PHYSICAL TRACK                               *
537                     ;*              [DE] - TRACK NUMBER                              *
538                     ;*                                                               *
539                     ;*****************************************************************
540
541                     DTRKSET:
542   0000 EB                 XCHG
543   0001 227004             SHLD    HSTTRK          ; SET TRACK
544   0004 C9                 RET
545
546
547                             PAGE
```

```
                    017    (08IOS)

548
549                 ;*****************************************************************
550                 ;*                                                               *
551                 ;*      DDIO    PHYSICAL READ AND WRITE                          *
552                 ;*                                                               *
553                 ;*****************************************************************
554
555   0005 C5       DDIO:   PUSH    B               ; SAVE [B]
556   0006 3A8D04           LDA     DSKCMD          ; LOAD COMMAND  ( READ OR WRITE )
557   0009 B7               ORA     A               ;
558   000A C2E200           JNZ     DDIOR           ; 1 = READ
559   000D 0E05             MVI     C,WRITDAT       ; WRITE DATA COMMAND BYTE
560   000F C3E400           JMP     DDIO1           ;
561   00E2 0E06     DDIOR:  MVI     C,READDAT       ; READ DATA COMMAND BYTE
562                 DDIO1:
563   00E4 3A6F04           LDA     HSTDSK
564   00E7 210000           LXI     H,NBRFLEX
565   00EA BE               CMP     M
566   00EB D20000           JNC     WINDRW
567   00EE CDF800           CALL    FDCSET          ; SET UP COMMAND STRING AND DMA
568   00F1 0609             MVI     B,9             ; B = NUMBER OF BYTES TO SEND TO FDC
569   00F3 CDCA02           CALL    FDCWAIT         ; SEND COMMAND STRING
570   00F6 C1               POP     B               ; RESTORE [B]
571   00F7 C9               RET                     ; RETURN STATUS
572
573
574
575
576                         PAGE
```

```
                ;*****************************************************************
                ;*                                                               *
                ;*     FDCSET  SETUP CONTROLL STRING FOR FDC                     *
                ;*             SEEK TRACK AND ACTIVATE DMA                       *
                ;*                                                               *
                ;*****************************************************************

                FDCSET:
00F8 C5                 PUSH    B               ; SAVE FUNCTION
00F9 CD5501             CALL    SETUPH          ; SET FUNCTION AND DRIVE
00FC E5                 PUSH    H               ; SAVE POINTER
00FD CD7601             CALL    TRKTRN          ; TRANSLATE TRACK NO.
0100 E1                 POP     H               ; RESTORE POINTER
0101 77                 MOV     M,A             ; SET TRACK
0102 23                 INX     H
0103 CD6801             CALL    FORMSIDE        ; RETURNS HEAD IN BIT 3
0106 0F                 RRC
0107 0F                 RRC
0108 77                 MOV     M,A             ; SET HEAD
0109 23                 INX     H
010A 3A7204             LDA     HSTSEC
010D E67F               ANI     01111111B       ; MASK OF SIDE SELECT BIT
010F 77                 MOV     M,A             ; SET SECTOR
0110 23                 INX     H
0111 3A6F04             LDA     HSTDSK          ; GET DISKNO.
0114 4F                 MOV     C,A             ;
0115 C5                 PUSH    B               ; SAVE DISKNO.
0116 E5                 PUSH    H               ; SAVE TABLE ADDRESS
0117 210000             LXI     H,DSKSLC        ; CODED SECTORLENGTH
011A CD0000             CALL    DSKGET          ; FETCH VALUE
011D E1                 POP     H               ; RESTORE TABLEADDRESS
011E 71                 MOV     M,C             ; AND WRITE TO TABLE
011F 23                 INX     H
0120 D1                 POP     D               ; RESTORE DISKNO.
0121 C5                 PUSH    B               ; SAVE CODED SECTORLENGTH
0122 4B                 MOV     C,E             ; MOVE DISKNO. TO C
0123 E5                 PUSH    H               ; SAVE TABLE ADDRESS
0124 210000             LXI     H,DSKMSC        ; MAXIMUM SECTOR NUMBER
0127 CD0000             CALL    DSKGET          ; GET VALUE INTO C
012A E1                 POP     H               ; RESTORE TABLE ADDRESS
012B 71                 MOV     M,C             ; AND WRITE TO TABLE
012C 23                 INX     H
012D 361B               MVI     M,GPL           ; GPL  = IBM FORMAT
012F 23                 INX     H
0130 36FF               MVI     M,0FFH          ; DTL
0132 CD2E03             CALL    SEEK1           ; SEEK TRACK
0135 D1                 POP     D               ; RESTORE CODED SECTORLENGTH
0136 C1                 POP     B               ; RESTORE FUNCTION
0137 79                 MOV     A,C
0138 FE46               CPI     046H
013A C8                 RZ                      ; RETURN IF READ TRACK
013B 1F                 RAR
013C 0608               MVI     B,DMAREAD       ; DMA READ FUNCTION
013E DA4301             JC      FDCSET1         ; JUMP IF WRITE FUNCTION
```

```
                        019     (OBIOS)

633   0141 0604                 MVI     B,DMAWRT        ; DMA WRITE FUNCTION (READ)
634                     FDCSET1:
635   0143 7B                   MOV     A,E             ; A=CODED SECTORL. 0=128 BYTES .. 3=1024 BYTES
636   0144 218000               LXI     H,128           ; CALCULATE SECTORLENGTH FROM CODED SL
637   0147 B7                   ORA     A               ; SET FLAGS
638   0148 CA5001               JZ      FDCSET3
639                     FDCSET2:
640   0148 29                   DAD     H               ; DOUBLE HL
641   014C 3D                   DCR     A
642   0140 C24801               JNZ     FDCSET2         ;
643                     FDCSET3:
644   015C 2B                   DCX     H               ; DMA LENGTH - 1
645   0151 CDAF02               CALL    DMA1            ; ACTIVATE DMA
646   0154 C9                   RET
647                     PAGE
```

```
                ;*****************************************************
                ;*                                                   *
                ;*   SETUPH     SET FUNCTION COMBINED WITH DENSITY   *
                ;*              AND DRIVE # COMBINED WITH HEAD INTO  *
                ;*              COMMAND BLOCK                        *
                ;*                    [C] FUNCTION                   *
                ;*****************************************************
                ;
                ;
0155 217304     SETUPH: LXI     H,COMBLO        ; COMMAND BLOCK FOR FDC
0158 3E40               MVI     A,DDEN
015A B1                 ORA     C
015B 77                 MOV     M,A             ; SET FUNCTION
015C 23                 INX     H
015D CD6801             CALL    FORMSIDE        ;COMPUTE SIDE BIT
0160 47                 MOV     B,A
0161 3A6F04             LDA     HSTDSK
0164 B0                 ORA     B
0165 77                 MOV     M,A             ; SET DRIVE
0166 23                 INX     H
0167 C9                 RET


                ;*****************************************************
                ;*                                                   *
                ;*      FORMSIDE        RETURNS SIDE BIT IN [A]      *
                ;*                                                   *
                ;*****************************************************

                FORMSIDE:
0168 E5                 PUSH    H
0169 CD9101             CALL    TYPBYT          ; GET TYPBYTE TO A
016C E601               ANI     01H             ; TEST BIT 0
016E CA7401             JZ      FMSID1          ; DONE IF SINGLE SIDED
0171 CD9D01             CALL    DSTRKTRN        ; RETURN SIDE BIT
0174 E1         FMSID1: POP     H               ; RESTORE [HL]
0175 C9                 RET                     ; RETURNS SIDE NUMBER IN BIT 0

                        PAGE
```

```
                    021    (OBIOS)

689
690                 ;*****************************************************************
691                 ;*                                                               *
692                 ;*      TRKTRN  RETURNS PHYSICAL TRACK NUMBER IN [A]             *
693                 ;*                                                               *
694                 ;*****************************************************************
695
696
697                 TRKTRN:
698   0176 CD9101           CALL    TYPBYT          ; GET TYPBYTE
699   0179 E607             ANI     00000111B       ;
700   017B CA8D01           JZ      TRKTE           ; SINGLE SIDED DISK
701   017E E606             ANI     00000110B       ;
702   0180 C28D01           JNZ     TRKTE           ; D-SIDE BUT SECTORS FOR ONE TRK ON BOTH SIDES
703   0183 CD8E01           CALL    GETTRK2         ; B = MAX TRACK / 2
704   0186 3A7004           LDA     HSTTRK
705   0189 B8               CMP     B
706   018A D8               RC
707   018B 90               SUB     B
708   018C C9               RET
709   018D 3A7004     TRKTE: LDA    HSTTRK
710   0190 C9               RET
711
712
713   0191 3A6F04     TYPBYT: LDA   HSTDSK
714   0194 4F               MOV     C,A
715   0195 210000           LXI     H,DSKSID
716   0198 CD0000           CALL    DSKGET
717   019B 79               MOV     A,C
718   019C C9               RET
719
720
721                 PAGE
```

```
722
723                     ;*****************************************************************
724                     ;*                                                               *
725                     ;*      DSTRKTRN        RETURN SIDE BIT IN [A]                   *
726                     ;*                                                               *
727                     ;*                                                               *
728                     ;*****************************************************************
729
730
731                     DSTRKTRN:
732   019D CD9101               CALL    TYPBYT          ; GET TYPBYTE
733   01A0 E606                 ANI     000001108       ;
734   01A2 C2B401               JNZ     DSTK2           ; SECTORS FOR ONE TRACK ON TWO SIDES
735   01A5 CDBE01               CALL    GETTRK2         ; B = MAX TRACK / 2
736   01A8 3A7004               LDA     HSTTRK          ; GET TRACK NUMBER
737   01AB B8                   CMP     B
738   01AC D2B101               JNC     DSTK1           ; JUMP IF SIDE 1
739   01AF AF                   XRA     A
740   01B0 C9                   RET
741   01B1 3E04       DSTK1:    MVI     A,SIDE1
742   01B3 C9                   RET
743
744   01B4 3A7204     DSTK2:    LDA     HSTSEC
745   01B7 E680                 ANI     080H
746   01B9 C2B101               JNZ     DSTK1           ; ON SIDE 2
747   01BC AF                   XRA     A
748   01B0 C9                   RET
749
750
751
752                     GETTRK2:                        ; RETURNS MAX TRACK / 2
753   01BE 3A6F04               LDA     HSTDSK          ; LOAD DISKNO.
754   01C1 4F                   MOV     C,A
755   01C2 210000               LXI     H,DSKTRK        ;
756   01C5 CD0000               CALL    DSKGET          ; FETCH MAX TRACK
757   01C8 79                   MOV     A,C
758   01C9 B7                   ORA     A               ; CLEAR CARRY BIT
759   01CA 1F                   RAR                     ; DIVIDE BY 2
760   01CB 47                   MOV     B,A
761   01CC C9                   RET
762
763
764
765                     PAGE
```

```
                        023    (OBIOS)

766
767                     ;*****************************************************************
768                     ;*                                                               *
769                     ;*      RECAL   RECALIBRATE                                      *
770                     ;*                                                               *
771                     ;*****************************************************************
772
773                     RECAL:
774                     DHOME:
775   01CD C5                   PUSH    B               ; SAVE (B) TO USE AS LOCAL REGISTER
776                     RECAL0:
777   01CE CDE601               CALL    HOME            ; JUST HOME
778   01D1 3A7C04               LDA     ERRBUF
779   01D4 E6E8                 ANI     0E8H
780   01D6 FE68                 CPI     068H
781   01D8 CAD001               JZ      RECAL2          ; JUMP IF DISK NOT READY
782   01DB C1                   POP     B
783   01DC C9                   RET                     ; RETURN
784
785                     RECAL2:
786   01DD 010101               LXI     B,0101H
787   01E0 CD9003               CALL    DSKERR          ; DISPLAY ERROR ROUTINE
788   01E3 C3CE01               JMP     RECAL0          ; RETRY
789
790                     PAGE


                        024    (OBIOS)

791
792                     ;*****************************************************************
793                     ;*                                                               *
794                     ;*      HOME    HOME DRIVE                                       *
795                     ;*                                                               *
796                     ;*****************************************************************
797
798                     HOME:
799   01E6 3A6F04               LDA     HSTDSK
800   01E9 210000               LXI     H,NBRFLEX
801   01EC BE                   CMP     M
802   01ED D20000               JNC     WINDRE          ; GOTO HARD DISK DRIVER
803   01F0 CD6403     HOME1:    CALL    MOTORCK         ; CHECK IF MOTOR ON
804   01F3 3E07                 MVI     A,RESTORE       ; RESTORE FUNCTION
805   01F5 D351                 OUT     DCOMD
806   01F7 CDF802               CALL    FDCRD1
807   01FA 3A6F04               LDA     HSTDSK          ; OUT DISK # (HEAD = 0)
808   01FD D351                 OUT     DCOMD
809   01FF CD0F03               CALL    FDCIN1          ; WAIT ON INTERRUPT (FNC FINISHED)
810   0202 3A7C04               LDA     ERRBUF
811   0205 E6E0                 ANI     0E0H
812   0207 FEC0                 CPI     0C0H
813   0209 CAF001               JZ      HOME1           ; RETRY - READY LINE CHANGED (MOTOR ON)
814   020C C9                   RET                     ; RETURN
815
816
817
818                     PAGE
```

```
                        025    (OBIOS)

819
820                     ;*****************************************************************
821                     ;*                                                               *
822                     ;*      READID  RETURNS ID BYTE IN [A]                           *
823                     ;*                                                               *
824                     ;*****************************************************************
825
826                     READID:
827   0200 3A0000               LDA     RETRYC          ; SET UP RETRY COUNTER
828   0210 47                   MOV     B,A             ;   IN (B)
829                     RDID1:
830   0211 C5                   PUSH    B               ; SAVE RETRY COUNTER
831   0212 CD2602               CALL    READSEC1        ; READ SECTOR1
832   0215 C1                   POP     B               ; RETRY COUNTER
833   0216 CA8A02               JZ      CHECKID         ; READ WAS OK
834   0219 0E01                 MVI     C,1             ; NO RECALIBRATE
835   021B CD9003               CALL    DSKERR          ; DETECT DISK ERRORS
836   021E 05                   DCR     B
837   021F C21102               JNZ     RDID1           ; RETRY
838
839                     RDIDXT2:
840   0222 3EFF                 MVI     A,0FFH
841   0224 B7                   ORA     A               ; SET NON ZERO FOR ERROR
842   0225 C9                   RET
843                             PAGE
```

```
                    026    (OBIOS)

844
845                 ;
846                 ;**********************************************************
847                 ;*                                                        *
848                 ;*  READSEC1    READ SECTOR 1 (NCR STANDARD DISK)         *
849                 ;*                                                        *
850                 ;**********************************************************
851                 ;
852                 ;
853                 ;
854                 READSEC1:
855   0226 CDCD01           CALL    RECAL           ; RESTORE DISK
856   0229 CD58C2           CALL    ID              ; READ CODED SECTORLENGTH FROM DISK RETURN IN A
857   022C C0               RNZ                     ; RET IF ERROR
858   022D 218304           LXI     H,MOUNTPB       ; PARAMETER BLOCK TO READ SECTOR 1
859   0230 117304           LXI     D,COMBLO        ; FDC CONTROL BLOCK
860   0233 010900           LXI     B,9             ; LENGTH
861   0236 ED               DB      0EDH            ; Z80 LDIR COMMAND  (DE) (- (HL)
862   0237 B0               DB      0B0H            ; HL=HL+1; DE=DE+1; BC=BC-1 REPEAT UNTIL BC=0
863   0238 217B04           LXI     H,COMBLO+5
864   023B 77               MOV     M,A             ;STORE CODED SECTORLENGTH
865   023C 217404           LXI     H,COMBLO+1
866   023F 3A6F04           LDA     HSTDSK
867   0242 B6               ORA     M
868   0243 77               MOV     M,A             ; COMBINE HEAD AND UNIT
869   0244 2100F6           LXI     H,HSTBUF
870   0247 229104           SHLD    PMAADR          ; SET DMA ADDRESS
871   024A 0604             MVI     B,DMAWRT
872   024C 21FF01           LXI     H,HSTSIZD-1
873   024F CDAF02           CALL    DMA1            ; INITIALIZE DMA
874   0252 0609             MVI     B,9
875   0254 CDCA02           CALL    FDCWAIT         ; SEND BYTES TO FDC
876   0257 C9               RET
877                         PAGE
```

```
878
879
880                     ;*****************************************************************
881                     ;*                                                               *
882                     ;*ID READS ID FIELD FROM DISK   RETURNS CODED SECTORLENGTH IN A *
883                     ;*                                                               *
884                     ;*****************************************************************
885
886  0258 3E4A      ID:     MVI     A,IDREAD OR DDEN        ; READ ID COMMAND
887  025A D351              OUT     DCOMD
888  025C CDF802            CALL    FDCRD1
889  025F 3A6F04            LDA     HSTDSK
890  0262 D351              OUT     DCOMD           ; SEND DISKNO.  ( HEAD 0 )
891  0264 DB13      ID01:   IN      SYSSTA          ; SENSE IF INTERRUPT
892  0266 E608              ANI     FDCIN
893  0268 CA6402            JZ      ID01
894  026B CDF802            CALL    FDCRD1
895  026E 0607              MVI     B,7             ; GET 7 BYTES
896  0270 CD4E03            CALL    GETBY1
897  0273 218204            LXI     H,ERRBUF+6      ;
898  0276 7E                MOV     A,M             ;LOAD CODED SECTORLENGTH
899  0277 C9                RET
900
901
902                             PAGE
```



```
903
904                     ;*****************************************************************
905                     ;*                                                               *
906                     ;*  CHECKOS     CHECK IF AN O.S. DISK IS MOUNTED                 *
907                     ;*                                                               *
908                     ;*****************************************************************
909                     CHECKOS:
910  0278 2103F6                LXI     H,HSTBUF+3
911  027B 118302                LXI     D,OSMSG
912  027E 0607                  MVI     B,7
913  0280 C30000                JMP     CMPRE           ; COMPARE TWO STRINGS
914
915  0283 435043203220OSMSG:    DB      'CPM 2.2'
916
917
918
919
920                             PAGE
```

```
                    029    (OBIOS)

921
922                 ;*****************************************************
923                 ;*                                                   *
924                 ;*   CHECKID    CHECKS IF THE SELECTED DISK IS       *
925                 ;*              AN NCR DISK                          *
926                 ;*                                                   *
927                 ;*****************************************************
928                 ;
929                 ;       ZERO SET IF VALID FORMAT
930                 ;       A = 0  -) TYP 0
931                 ;       A = 1  -) TYP 1
932                 ;       A = 2  -) TYP 2
933                 ;
934                 ;
935                 ;
936                 ;
937                 CHECKID:
938   028A 210AF6           LXI     H,HSTBUF+10
939   028D 11AA02           LXI     D,CHECKMSG
940   0290 0605             MVI     B,5
941   0292 CD0000           CALL    CMPRE
942   0295 C2A802           JNZ     CKID3
943   0298 7E               MOV     A,M             ; GET ID
944   0299 FE31             CPI     '1'
945   029B CAA202           JZ      CKID2           ; JUMP IS DDSS
946   029E 3D               DCR     A
947   029F FE32             CPI     '2'
948   02A1 C0               RNZ                     ; ERROR
949   02A2 D630     CKID2:  SUI     '0'             ; CONVERT IO BINARY
950   02A4 47               MOV     B,A
951   02A5 AF               XRA     A
952   02A6 78               MOV     A,B
953   02A7 C9               RET
954   02A8 AF       CKID3:  XRA     A               ; TYP 0
955   02A9 C9               RET
956                 ;
957                 ;
958                 ;
959                 ;
960                 ;
961   02AA 4E43522046CHECKMSG:      DB      'NCR F'         ; FORMAT MESSAGE
962                         PAGE
```

```
963
964                     ;*****************************************************************
965                     ;*                                                               *
966                     ;*      DMA     INITIALIZE DMA                                   *
967                     ;*              HL - SECTOR SIZE                                 *
968                     ;*              B  - DMA COMMAND                                 *
969                     ;*                                                               *
970                     ;*****************************************************************
971
972                     DMA1:
973   02AF 3E43                 MVI     A,43H
974   0281 B0                   ORA     B
975   0282 D32B                 OUT     DMAMO           ; OUT MODE
976   0284 E5                   PUSH    H
977   0285 2A9104               LHLD    PMAADR          ; GET DMA ADDRESS
978   0288 7D                   MOV     A,L
979   0289 D326                 OUT     COAD            ; OUT ADDRESS LOW
980   028B 7C                   MOV     A,H
981   028C D326                 OUT     COAD            ; OUT ADDRESS HIGH
982   028E E1                   POP     H
983   028F 7D                   MOV     A,L
984   02C0 D327                 OUT     COTC            ; OUT DMA LENGTH LOW
985   02C2 7C                   MOV     A,H
986   02C3 D327                 OUT     COTC            ; OUT DMA LENGTH HIGH
987   02C5 3E03                 MVI     A,ENFD
988   02C7 D32A                 OUT     DMAMB           ; ENABLE FDC CHANNEL
989   02C9 C9                   RET
990
991                             PAGE
```

```
                        031    (QBIOS)

 992
 993                    ;*****************************************************************
 994                    ;*                                                               *
 995                    ;*      FDCWAIT         SEND COMMAND BYTES (LENGTH IN BC)        *
 996                    ;*                      TO FDC                                   *
 997                    ;*                                                               *
 998                    ;*                                                               *
 999                    ;*****************************************************************
1000
1001                    FDCWAIT:
1002   02CA CD6403              CALL    MOTORCK         ; CHECK IF MOTOR ON
1003   02CD 217304              LXI     H,COMBLO
1004   02D0 05                  DCR     B
1005   02D1 7E          FDCWAIT1:MOV     A,M
1006   02D2 D351                OUT     DCOMD           ; SEND BYTE TO FDC
1007   02D4 CDF802              CALL    FDCRD1          ; WAIT UNTIL FDC IS READY TO RECEIVE NEXT
1008   02D7 23                  INX     H
1009   02D8 05                  DCR     B
1010   02D9 C20102              JNZ     FDCWAIT1        ; NOT ALL SEND
1011   02DC 7E                  MOV     A,M
1012   02DD D351                OUT     DCOMD           ; SEND LAST BYTE
1013   02DF CDFF02              CALL    DMA01
1014   02E2 D2F002              JNC     FDCWER          ;JUMP IF DISK NOT READY
1015   02E5 0607                MVI     B,07H
1016   02E7 CD4E03              CALL    GETBY1          ; GET STATUS BYTES
1017   02EA CAEE02              JZ      FDCWXT          ; GOOD STATUS
1018   02ED C9                  RET                     ; BAD STATUS
1019
1020                    FDCWXT:
1021   02EE AF                  XRA     A
1022   02EF C9                  RET
1023                    FDCWER:
1024   02F0 3E80                MVI     A,80H           ;SPEZIAL NOT READY
1025                    FDCWE1:
1026   02F2 217C04              LXI     H,ERRBUF        ;SAVE SPEZIAL ERROR CODE
1027   02F5 77                  MOV     M,A             ;INTO ERROR BUFFER FOR
1028                                                    ;DISK NOT READY IN EXECUTION
1029   02F6 B7                  ORA     A               ; PHASE
1030   02F7 C9                  RET
1031                            PAGE
```

```
1032
1033                ;*****************************************************************
1034                ;*                                                               *
1035                ;*      FDCRD1  WAIT UNTIL FDC IS READY                          *
1036                ;*              ENTER WITH COMMAND IN [C]                        *
1037                ;*                                                               *
1038                ;*****************************************************************
1039
1040  02F8 DB50     FDCRD1: IN      DSTAT           ; GET MAIN STATUS
1041  02FA 17               RAL
1042  02FB D2F802           JNC     FDCRD1          ; JUMP IF FDC NOT READY
1043  02FE C9               RET
1044
1045
1046
1047
1048                ;*****************************************************
1049                ;*                                                   *
1050                ;*   DMA01                                           *
1051                ;*                                                   *
1052                ;*****************************************************
1053                DMA01:
1054  02FF DB13             IN      SYSSTA          ; GET STATUS
1055  0301 E604             ANI     04H             ; TEST READY LINE
1056  0303 C8               RZ                      ; RETURN IF DISK NOT READY
1057  0304 DB50             IN      DSTAT
1058  0306 17               RAL
1059  0307 D2FF02           JNC     DMA01           ; JUMP IF NO MASTER REQUEST
1060  030A 3E07             MVI     A,DISFD
1061  030C D32A             OUT     DMAMB           ; DISABLE FDC CHANNEL
1062  030E C9               RET                     ; CARRY SET - DISK WAS READY
1063
```

```
                    033    (OBIOS)

1064
1065                ;
1066                ;**************************************************************
1067                ;*                                                            *
1068                ;*   FDCINI1     WAIT UNTIL FDC HAS BEEN INTERRUPTED          *
1069                ;*                                                            *
1070                ;**************************************************************
1071                ;
1072                ;
1073                FDCIN1:
1074
1075  030F DB13             IN      SYSSTA          ;GET STATUS
1076  0311 E608             ANI     FDCIN
1077  0313 CA0F03           JZ      FDCIN1          ;JUMP IF NO INTERRUPT
1078  0316 CDF802           CALL    FDCRD1
1079                ;
1080                ;       RESET INTERRUPT
1081                ;
1082  0319 3E08             MVI     A,FDCSIS        ; SENSE INTERRUPTSTATUS
1083  031B D351             OUT     DCOMD
1084  031D CDF802           CALL    FDCRD1          ; WAIT UNTIL FDC READY
1085  0320 DB51             IN      FDCRA
1086  0322 327C04           STA     ERRBUF          ; SAVE ST0
1087  0325 CDF802           CALL    FDCRD1          ; WAIT UNTIL FDC READY
1088  0328 DB51             IN      FDCRA
1089  032A CDF802           CALL    FDCRD1
1090  032D C9               RET
1091                        PAGE


                    034    (OBIOS)

1092
1093                ;
1094                ;
1095                ;**************************************************************
1096                ;*                                                            *
1097                ;*    SEEK1     SEEK AN SPECIFIED TRACK                       *
1098                ;*                                                            *
1099                ;**************************************************************
1100                ;
1101                ;
1102  032E CD6403   SEEK1:  CALL    MOTORCK         ; CHECK IF MOTOR IS ON
1103  0331 3E0F             MVI     A,SEEKTRK
1104  0333 D351             OUT     DCOMD           ; SEND SEEK COMMAND
1105  0335 CDF802           CALL    FDCRD1
1106  0338 3A6F04           LDA     HSTDSK
1107  0338 6F               MOV     L,A             ; SAVE DISK #
1108  033C CD6801           CALL    FORMSIDE        ; GET HEAD BIT
1109  033F B5               ORA     L               ; COMBINE HEAD WITH DRIVE #
1110  0340 D351             OUT     DCOMD           ; SEND UNIT&HEAD
1111  0342 CDF802           CALL    FDCRD1
1112  0345 CD7601           CALL    TRKTRN          ; GET TRACK #
1113  0348 D351             OUT     DCOMD           ; SEND TRACK #
1114  034A CD0F03           CALL    FDCIN1
1115  034D C9               RET
1116                        PAGE
```

```
1117
1118                    ;*****************************************************************
1119                    ;*                                                               *
1120                    ;*  GETBY1    GET SPECIFIED # OF STATUS BYTES FROM FDC          *
1121                    ;*            B - # NUMBER OF STATUS BYTES                       *
1122                    ;*                                                               *
1123                    ;*****************************************************************
1124                    ;
1125                    ;
1126  034E 217C04       GETBY1: LXI     H,ERRBUF
1127  0351 DB51         GETBY2: IN      FDCRA
1128  0353 77                   MOV     M,A
1129  0354 CDF802               CALL    FDCRD1          ;WAIT UNTIL FDC IS READY
1130  0357 23                   INX     H
1131  0358 05                   DCR     B
1132  0359 C25103               JNZ     GETBY2          ; JUMP IF NOT ALL STATUS BYTES FETCHED
1133  035C 217C04               LXI     H,ERRBUF
1134  035F 7E                   MOV     A,M
1135  0360 E6C0                 ANI     0C0H
1136  0362 B7                   ORA     A
1137  0363 C9                   RET                     ; RETURN WITH STATUS
1138                            PAGE
```



```
1139
1140                    ;*****************************************************************
1141                    ;*                                                               *
1142                    ;*      MOTORCK         CHECK IF MOTOR ON , OTHERWISE WAIT 1 SEC*
1143                    ;*                                                               *
1144                    ;*****************************************************************
1145
1146
1147                    MOTORCK:
1148  0364 DB13                 IN      SYSSTA          ; GET SYSTEM STATUS
1149  0366 E601                 ANI     MOTOROFF
1150  0368 D314                 OUT     MOTORON         ; SWITCH MOTOR ON
1151  036A C8                   RZ                      ; RETURN IF MOTOR WAS ON
1152                    ;
1153                    ;       WAIT 1 SEC
1154                    ;
1155  036B D5                   PUSH    D
1156  036C C5                   PUSH    B
1157  036D 160A                 MVI     D,10
1158  036F 010035       TIM1:   LXI     B,03500H
1159  0372 0B           TIM2:   DCX     B               ; WAIT 100 MS
1160  0373 78                   MOV     A,B
1161  0374 B1                   ORA     C
1162  0375 C27203               JNZ     TIM2
1163  0378 15                   DCR     D
1164  0379 C26F03               JNZ     TIM1
1165  037C C1                   POP     B
1166  037D D1                   POP     D
1167  037E C9                   RET
1168                            PAGE
```

```
                    037    (08IOS)

1169
1170                ;*****************************************************************
1171                ;*                                                               *
1172                ;*      RESET:  INITIALIZE PARAMETERS                            *
1173                ;*                                                               *
1174                ;*****************************************************************
1175
1176
1177                RESET:
1178   037F 3EFF            MVI     A,0FFH
1179   0381 0604            MVI     B,4
1180   0383 210000          LXI     H,DSKTYP
1181                RESET1:
1182   0386 77              MOV     M,A
1183   0387 23              INX     H
1184   0388 05              DCR     B
1185   0389 C28603          JNZ     RESET1
1186   038C CD0000          CALL    CLOSE
1187   038F C9              RET
1188                        PAGE
```

```
1189
1190            ;*****************************************************************
1191            ;*                                                               *
1192            ;*     DISK ERROR ROUTINE                                        *
1193            ;*             RETRY COUNTER IN [BC]                             *
1194            ;*                                                               *
1195            ;*             EXIT:                                             *
1196            ;*                     B = 1  C = 1 --) OVERRIDE                 *
1197            ;*                     B ) 1        --) RETRY                    *
1198            ;*                     NO RETURN    --) ABNORMAL TERMINATION     *
1199            ;*                                                               *
1200            ;*****************************************************************
1201            DSKERR:
1202  0390 E5                   PUSH    H               ;SAVE REGISTERS
1203  0391 D5                   PUSH    D
1204  0392 C5                   PUSH    B
1205  0393 217C04               LXI     H,ERRBUF        ;GET STATUS WORD
1206  0396 7E                   MOV     A,M             ;
1207  0397 E6C0                 ANI     0C0H            ;TEST FOR SPEZIAL NOT READY
1208  0399 FE80                 CPI     80H
1209  0398 010000               LXI     B,NOTRDYM       ; ERROR MESSAGE
1210  039E CAD103               JZ      DISPER          ;JUMP IF DISK NOT READY
1211  03A1 7E                   MOV     A,M             ;           0
1212  03A2 E608                 ANI     08H
1213  03A4 010000               LXI     B,NRDYRX        ; ERROR MESSAGE
1214  03A7 C2D103               JNZ     DISPER          ;NOT READY
1215  03AA 23                   INX     H               ;    STATUS WORD
1216  03AB 7E                   MOV     A,M             ;           1
1217  03AC E602                 ANI     02H             ;
1218  03AE 010000               LXI     B,WRPRCTM       ; ERROR MESSAGE
1219  0381 C2D103               JNZ     DISPER          ; WRITE PROTECT
1220
1221  0384 C1                   POP     B               ;RESTORE RETRY COUNTER
1222  0385 78                   MOV     A,B             ;GET LOOP COUNTER
1223  0386 FE01                 CPI     1               ;
1224  0388 C2C103               JNZ     ERLOOP          ;JUMP IF RETRY
1225  038B 79                   MOV     A,C             ;GET LOOP COUNTER 2
1226  038C FE01                 CPI     1                       ;
1227  038E CAC403               JZ      IOERR           ;I/O ERROR OR FATAL ERROR
1228                    ERLOOP:
1229  03C1 D1                   POP     D               ; RESSTORE REGISTERS
1230  03C2 E1                   POP     H
1231  03C3 C9                   RET
1232                    IOERR:
1233  03C4 C5                   PUSH    B               ;CORRECT STACK
1234  03C5 7E                   MOV     A,M             ;    STATUS WORD
1235  03C6 E695                 ANI     95H             ;           1
1236  03C8 010000               LXI     B,FATERRM       ; ERROR MESSAGE
1237  03CB C2D103               JNZ     DISPER          ;FATAL ERROR
1238  03CE 010000               LXI     B,IOERRM        ; ERROR MESSAGE
1239                    DISPER:
1240  0301 60                   MOV     H,B
1241  0302 69                   MOV     L,C
1242                    DISPE1:
1243  0303 E5                   PUSH    H               ;SAVE POINTER
1244  0304 3A6F04               LDA     HSTDSK          ;GET DRIVE #
```

```
                        039     (OBIOS)

1245    03D7 3C                 INR     A               ;CONVERT IT TO ASCII
1246    03D8 F640               ORI     40H             ;
1247    03DA 77                 MOV     M,A             ;SAVE IT INTO ERROR MESSAGE
1248                    DISPE2:
1249    03DB E5                 PUSH    H               ;SAVE CURRENT ERROR MESSAGE
1250    03DC 2A0000             LHLD    CURCOL          ;GET CURSOR
1251    03DF 220000             SHLD    TMPCOL          ;SAVE CURSOR TEMPORARELY
1252    03E2 210018             LXI     H,01800H                ;POSITION CURSOR
1253    03E5 220000             SHLD    CURCOL
1254    03E8 E1                 POP     H               ;RETRIEVE ERROR MESSAGE
1255    03E9 CD0000             CALL    DISPERR         ;DISPLAY ERROR MESSEGE LINE 25
1256    03EC CD0000             CALL    CONIN           ;GET CONSOLE CHARACTER
1257    03EF E65F               ANI     05FH            ;CONVERT LOWER CASE TO UPPERCASE LETTER
1258    03F1 F5                 PUSH    PSW             ;SAVE INPUT CHARACTER
1259    03F2 2A0000             LHLD    TMPCOL          ;GET OLD CURSOR POSITION
1260    03F5 220000             SHLD    CURCOL          ;RESTORE IT
1261    03F8 217C04             LXI     H,ERRBUF        ;GET STATUS 0 OF ERRBUF
1262    03FB 7E                 MOV     A,M             ;TEST FOR SPEZIAL
1263    03FC E6C0               ANI     0C0H            ;NOT READY
1264    03FE FE80               CPI     080H            ;
1265    0400 CA2104             JZ      DISRE1          ;JUMP IF SPEZIAL NOT READY
1266    0403 7E                 MOV     A,M             ;GET STATUS 0 OF ERRBUF
1267    0404 E608               ANI     08              ;TEST FOR NOT READY
1268    0406 C21D04             JNZ     DISNRY          ;JUMP IF NOT READY
1269    0409 F1                 POP     PSW             ;RESTORE INPUT CHARACTER
1270    040A FE4F               CPI     'O'             ;
1271    040C CA5404             JZ      DISOVE          ;JUMP IF OVERRIDE
1272                    DISRX:
1273    040F FE52               CPI     'R'
1274    0411 CA4004             JZ      DISRET          ;JUMP IF RETRY
1275    0414 FE58               CPI     'X'
1276    0416 CA5B04             JZ      DISBOT          ;JUMP IF ABNORMAL TERMINATION
1277    0419 E1                 POP     H               ;RESTORE OLD ERROR MESSAGE
1278    041A C30303             JMP     DISPE1          ;DISPLAY MESSAGE ONCE MORE
1279                    DISNRY:
1280    041D F1                 POP     PSW             ;RESTORE INPUT CHARACTER
1281    041E C30F04             JMP     DISRX
1282                    DISRE1:
1283    0421 F1                 POP     PSW             ;GET INPUT CHARACTER
1284    0422 FE52               CPI     'R'
1285    0424 E1                 POP     H               ;RESTORE OLD ERROR MESSAGE
1286    0425 C20303             JNZ     DISPE1          ;JUMP IF NOT 'R'
1287    0428 CD6403             CALL    MOTORCK         ; CHECK IF MOTOR ON
1288    042B DB13               IN      SYSSTA          ;GET STATUS
1289    042D E604               ANI     04H             ;
1290    042F CA0303             JZ      DISPE1          ;JUMP IF DISK NOT READY
1291    0432 3E07               MVI     A,DISFD
1292    0434 D32A               OUT     DMAMB           ; DISABLE FDC CHANNEL
1293                    DISRE2:
1294    0436 DB51               IN      FDCRA           ;GET BYTE FROM FDC
1295    0438 CDF802             CALL    FDCRD1          ;WAIT TIL READY
1296    043B 17                 RAL
1297    043C DA3604             JC      DISRE2          ;GET NEXT BYTE
1298    043F E5                 PUSH    H               ;CORRECT STACK
1299                    DISRET:
1300    0440 E1                 POP     H               ;
```

```
                        040    (OBIOS)

1301   0441 3A0000              LDA     RSTC            ;GET OUTER LOOP COUNTER
1302   0444 4F                  MOV     C,A
1303   0445 3A0000              LDA     RETRYC          ;GET INNER LOOP COUNTER
1304   0448 47                  MOV     B,A
1305                    DISEND:
1306   0449 E1                  POP     H               ;CLEAR STACK
1307   044A C5                  PUSH    B
1308   044B 3E18                MVI     A,24            ;CLEAR ERROR LINE
1309   044D CD0000              CALL    CLRLIN
1310   0450 C1                  POP     B
1311   0451 D1                  POP     D               ;RESTORE REGISTERS
1312   0452 E1                  POP     H
1313   0453 C9                  RET
1314                    DISOVE:                         ;OVERRIDE
1315   0454 E1                  POP     H               ;CLEAR STACK
1316   0455 010101              LXI     B,0101H         ;NO RETRY
1317   0458 C34904              JMP     DISEND
1318                    DISBOT:
1319   0458 3E18                MVI     A,24            ;CLEAR ERROR LINE
1320   0450 CD0000              CALL    CLRLIN
1321   0460 AF                  XRA     A
1322   0461 320400              STA     CURDISK         ;SELECT DRIVE "A"
1323   0464 C30000              JMP     WBOTE           ;ABNORMAL TERMINATION
1324
1325
1326                            PAGE
```

```
041    (08IOS)

1327
1328            ;*****************************************************************
1329            ;*****************************************************************
1330            ;*                                                               *
1331            ;*              DISK WORKING STORAGE                             *
1332            ;*                                                               *
1333            ;*****************************************************************
1334            ;*****************************************************************
1335            ;*                                                               *
1336            ;*               BLOCKING DATA AREA                              *
1337            ;*                                                               *
1338            ;*****************************************************************
1339
1340
1341   0467             SEKDSK  DS      1
1342   0468             SEKTRK  DS      2
1343   046A             SEKSEC  DS      1
1344
1345   046B             UNADSK  DS      1
1346   046C             UNATRK  DS      2
1347   046E             UNASEC  DS      1
1348
1349   046F             HSTDSK  DS      1
1350   0470             HSTTRK  DS      2
1351   0472             HSTSEC  DS      1
1352
1353
1354
1355
1356                            PAGE
```

```
                ;*****************************************************************
                ;*                                                               *
                ;*                DISK COMMAND AND ERROR BUFFER                  *
                ;*                                                               *
                ;*****************************************************************


0473            COMBLO  DS      9               ; FDC OR FIX COMMAND BLOCK
047C            ERRBUF  DS      7               ; FDC ERROR BUFFER


                ;*****************************************************************
                ;*                                                               *
                ;*      PARAMETER BLOCK FOR SECTOR 1 READ                        *
                ;*                                                               *
                ;*****************************************************************

0483 46         MOUNTP8:DB      DDEN OR READDAT ; FUNCTION
0484 00                 DB      0               ; HEAD = 0
0485 00                 DB      0               ; CYLINDER = 0
0486 00                 DB      0               ; HEAD = 0
0487 01                 DB      1               ; SECTOR = 1
0488 02                 DB      DDIND           ; DENSITY INDICATOR
0489 08                 DB      FDCEOT          ; # OF SECTORS / TRACK
048A 18                 DB      GPL             ; GAP LENGTH
048B FF                 DB      0FFH            ; DTL
```



```
                ;*****************************************************************
                ;*                                                               *
                ;*                    MISC DISK DATA                             *
                ;*                                                               *
                ;*****************************************************************


048C 00         BTRECS: DB      0               ; # OF O.S. SECTORS TO LOAD
048D            DSKCMD  DS      1
048E            UNACNT  DS      1
048F            DMAADR  DS      2
0491            PMAADR  DS      2
0493            RSFLAG  DS      1
0494            READOP  DS      1
0495            WRTYPE  DS      1
0496            HSTACT  DS      1
0497            HSTWRT  DS      1
0498            SEKHST  DS      1
0499            ERFLAG  DS      1               ;ERROR FLAG
049A            SAVESEC DS      1               ;SAVE FOR OLD HSTSEC AFTER SECTORTRANSLATE

049B                    END
```

```
                        044     (OBIOS)

ALV0            FA80    160#    161
ALV1            FAE0    162#    163
ALV2            FB71    164#    166
ALV3            FBC2    166#    168
ALV4            FC13    168#    170
ALV5            FC64    170#    172
ALV6            FCB5    172#    174
ALV7            FD06    174#    176
ALV8            FD57    176#    178
ALV9            FDA8    178#    180
BLKSIZ          0800    237#
BS              0008    204#
BTRECS          048C     94    1397#
CHECKID         028A    833    937#
CHECKMSG        029A    939    961#
CHECKOS         0278     99    909#
CKID2           02A2    945    949#
CKID3           02A8    942    954#
CLOSE           0000     76    490   1186
CLRLIN          0000     78   1309   1320
CLRSCN          001A    208#
CMPRE           0000     75    913    941
COAD            0026    132#   979    981
COMBLO          0473    101    658    859    863    865   1003   1365#
COMIN           0000     78   1256
COTC            0027    133#   984    986
CPMSPTD         0020    242#
CR              0000    202#
CRDTR1          0099    448    453#
CREAD           0028    100    360#
CSV0            FAA0    161#   162
CSV1            FB31    163#   164
CSV2            0000    165#
CSV3            0000    167#
CSV4            0000    169#
CSV5            0000    171#
CSV6            0000    173#
CSV7            0000    175#
CSV8            0000    177#
CSV9            0000    179#
CURCOL          0000     76   1250   1253   1260
CURDISK         0004    201#  1322
CWRITE          0024    100    349#
DCOMD           0051    120#   805    808    887    890   1006   1012   1083   1104   1110
                       1113
DDEN            0040    287#   659    886   1376
DDIND           0002    286#   405   1381
DDIO            0005    323    373    384    555#
DDIO1           00E4    560    562#
DDIOR           00E2    558    561#
DHOME           01CD    101    774#
DIO1            0004    319#   332
DIO2            0008    322#   327
DIRBUF          FA00    159#   160
DISBOT          0458   1276   1318#
DISEND          0449   1305#  1317
```

```
                    046    (OBIOS)

FDCIN1              030F   809  1073# 1077  1114
FDCRA               0051   122# 1085  1088  1127  1294
FDCRD1              02F8   806   888   894  1007  1040# 1042  1078  1084  1087  1089
                           1105  1111  1129  1295
FDCSET              00F8   442   567   586#
FDCSET1             0143   632   634#
FDCSET2             014B   639#  642
FDCSET3             0150   638   643#
FDCSIS              0008   302#  1082
FDCWAIT             02CA   418   447   569   875  1001#
FDCWAIT1            02D1   1005# 1010
FDCWE1              02F2   1025#
FDCWER              02F0   1014  1023#
FDCWXT              02EE   1017  1020#
FF                  000C   205#
FIXINIT             0000    75   499
FLUSH               0000    75   489
FMSID1              0174   683   685#
FORMATT             0042   100   397#  423
FORMSIDE            0168   594   663   679#  1108
FREAD               003A   102   382#
FWRITE              0033   102   371#
GETBY1              034E   896  1016  1126#
GETBY2              0351  1127# 1132
GETTRK2             01BE   703   735   752#
GPL                 001B   288#  621  1383
HOME                01E6   777   798#
HOME1               01F0   803#  813
HSTACT              0496    98  1405#
HSTBLKD             0004   241#  242   243   244   245
HSTBUF              F600   158#  159   869   910   938
HSTDSK              046F    98   399   563   603   665   713   753   799   807   866
                           889  1106  1244  1349#
HSTSEC              0472    98   440   531   599   744  1351#
HSTSIZD             0200   239#  241   444   872
HSTSPTD             0008   240#  242   415   444
HSTTRK              0470    98   515   543   704   709   736  1350#
HSTWRT              0497    98  1406#
ID                  0258   856   886#
ID01                0264   891#  893
IDREAD              000A   303#  886
IOBYTE              0003   200#
IOERR               03C4  1227  1232#
IOERRM              0000    77  1238
LF                  000A   203#
LINBUF              FDF9   180#  181
MOTORCK             0364   803  1002  1102  1147# 1287
MOTOROFF            0001   124#  1149
MOTORON             0014   131#  1150
MOUNTPB             0483   858  1376#
MOVE                0000    76
NBRFLEX             0000    79   400   493   564   800
NOTRDYM             0000    77  1209
NRDYRX              0000    77  1213
OSMSG               0283   911   915#
PMAADR              0491    94   473   870   977  1401#
```

```
RAMSEL          0010   127#
RDID1           0211   829#  837
RDIDXT2         0222   839#
RDTRAK          0078   100   438#  457
READDAT         0006   300#  561  1376
READID          0200   101   826#
READOP          0494    95  1403#
READSEC1        0226    99   831   854#
READTRK         0002   298#
RECAL           0100   331   773#  855
RECALO          01CE   776#  788
RECAL2          0100   781   785#
RESET           037F    99  1177#
RESET1          0336  1181#  1185
RESTORE         0007   301#  804
RETRYC          0000    75   320   827  1303
ROMSEL          0011   128#
RSFLAG          0493    98  1402#
RSTC            0000    75   317  1301
RWERR           0010   330   335#  424   458
SAVESEC         049A    94  1409#
SECMSKD         0003   243#
SECSET          00C8   100   530#
SECSHFD         0002   270#
SEEK1           032E   413   624  1102#
SEEKTRK         000F   305#  1103
SEKDSK          0467    96  1341#
SEKHST          0498    96  1407#
SEKSEC          046A    96  1343#
SEKTRK          0468    96  1342#
SETTC           0012   129#
SETUPH          0155   404   588   658#
SIDE1           0004   281#  741
SYSSTA          0013   130#  891  1054  1075  1148  1288
TIM1            036F  1158#  1164
TIM2            0372  1159#  1162
TMPCOL          0000    76  1251  1259
TOF             000C   206#
TRKSET          00C4   100   513#
TRKTE           0180   700   702   709#
TRKTRM          0176   590   697#  1112
TYPBYT          0191   681   698   713#  732
UNACNT          048E    97  1399#
UNADSK          0468    97  1345#
UNASEC          046E    97  1347#
UNATRK          046C    97  1346#
UNITHI          0002   283#
UNITLO          0000   282#
WBOTE           0000    78  1323
WINDFM          0000    79   402
WINDRE          0000    79   802
WINDRW          0000    79   566
WRITDAT         0005   299#  559
WRITFMT         0000   304#  398
WRPRCTM         0000    77  1218
WRTYPE          0495    95  1404#
L
```

```
                        003    (PBIOS)

 69
 70                     ;*****************************************************************
 71                     ;*****************************************************************
 72                     ;********                                              ********
 73                     ;********       EXTERNAL DEFINITIONS                   ********
 74                     ;********                                              ********
 75                     ;*****************************************************************
 76                     ;*****************************************************************
 77                     ;
 78                     ;
 79                     ;
 80                     EXTRN   MULT,COMPDEHL,FUNCCH,CRTTBL,SIOINIT,PIOINIT
 81                     EXTRN   IOBSET,SRLINST,KEYST,SRLIN,KEYIN,SRLOUT
 82                     EXTRN   PRTOUT,SRLOUT,SRLSTAT,PRTSTAT,SUBHLDE
 83                     EXTRN   KBDINIT,LANGUAGE,GETLPOS,SACTIVE,CLRLIN
 84                     EXTRN   DESLCT,TRANS
 85
 86
 87
 88
 89
 90                             PAGE



                        004    (PBIOS)

 91
 92                     ;*****************************************************************
 93                     ;*****************************************************************
 94                     ;********                                              ********
 95                     ;********       ENTRY DEFINITIONS                      ********
 96                     ;********                                              ********
 97                     ;*****************************************************************
 98                     ;*****************************************************************
 99                     ;
100                     ;
101                     ;
102                     PUBLIC  DRQ,DRQADR,CURCOL,TMPCOL,TRNCHR,TRNSPC,POPREG,CLRLI1,ROUTE
103                     PUBLIC  CONST,CONIN,LIST,PUNCH,READER,LISTST,CINIT,WINIT
104                     PUBLIC  CONOUT,MODCRT,WRCUPO,CLRLI1
105
106                             PAGE
```

```
107
108                     ;MACRO CALLS
109                     KEYEQU
110      +              ;*****************************************************************
111      +              ;*                                                               *
112      +              ;*                  KEYBOARD EQUATES 27/10/82 10:27 WF           *
113      +              ;*                                                               *
114      +              ;*****************************************************************
115   0040+=            KEYBASE EQU     0040H           ; BASE ADDRESS OF KEYBOARD
116      +
117   0040+=            WDKEY   EQU     KEYBASE         ; WRITE DATA TO KEYBOARD
118   0040+=            RDKEY   EQU     KEYBASE         ; READ DATA FROM KEYBOARD
119   0041+=            RSKEY   EQU     KEYBASE+1       ; READ KEYBOARD STATUS
120   0041+=            KBELL   EQU     KEYBASE+1       ; RING BELL
121   0041+=            KCOUNT  EQU     KEYBASE+1       ; COUNTRY CODE PORT
122      +
123   0002+=            INPBFF  EQU     02H             ; INPUTBUFFER FULL
124   0001+=            OUTPBFF EQU     01H             ; OUTPUTBUFFER FULL
125   0080+=            LGDAT   EQU     80H             ; LANGUAGE CODE READY FLAG
126   0001+=            KBDAT   EQU     01H             ; DATA READY BIT
127   0001+=            COUNTRY EQU     01H             ; COMMAND TO GET COUNTRY CODE
128   0006+=            MUSICC  EQU     06H             ; MUSIC COMMAND
129      +              ;
130      +                      ENDM
131                     VERSEQU
132      +              ;*****************************************************************
133      +              ;*                                                               *
134      +              ;*                    SWITCHES 07.06.83   10:00 PM               *
135      +              ;*                                                               *
136      +              ;*****************************************************************
137      +
138   0000+=            CPMRAM  EQU     0               ; CP/M RAM BASE
139   0002+=            CPMVER  EQU     2               ; CP/M VERSION
140   0000+=            RELEASEH        EQU     0       ; MCR RELEASE HIGH BYTE
141   0004+=            RELEASE EQU     4               ; MCR RELEASE LOW BYTE
142   0000+=            MCRVERH EQU     0               ; MCR VERSION HIGH BYTE
143   0004+=            MCRVER  EQU     4               ; MCR VERSION LOW BYTE
144   0001+=            DNBRR   EQU     1               ; D-NUMBER RELEASE
145   0000+=            DNBRS   EQU     0               ; D-NUMBER SUBISSUE
146   0FF7+=            FWVER   EQU     0FF7H           ; LOCATION OF FWVERSION IN FIRMWARE
147      +                      PAGE
```

```
                    006    (P8IOS)

148       +
149       +                 ENDM
150                 CNTLEQU
151       +         ;*****************************************************************
152       +         ;*                                                               *
153       +         ;*      CONTROL CHARACTER EQUATES 27/10/82 10:22 WF              *
154       +         ;*                                                               *
155       +         ;*****************************************************************
156       +
157       +
158   0003+=        IOBYTE  EQU     3               ; I/O BYTE
159   0004+=        CURDISK EQU     4               ; CURRENT DISK NUMBER
160   000D+=        CR      EQU     0DH             ; CARRIGE RETURN
161   000A+=        LF      EQU     0AH             ; LINE FEED
162   0008+=        BS      EQU     08H             ; BACK SPACE
163   000C+=        FF      EQU     0CH             ; FORM FEED
164   000C+=        TOF     EQU     0CH             ; TOP OF FORM
165   001B+=        ESC     EQU     1BH             ; ESCAPE
166   001A+=        CLRSCN  EQU     01AH            ; CLEAR SCREEN
167       +                 PAGE
```

```
168       +
169       +                 ENDM
170                 DISKBFF
171       +
172       +         ;*****************************************************************
173       +         ;*                                                               *
174       +         ;*              DISK BUFFER MACRÓ 11.03.83 17.15 PH              *
175       +         ;*                                                               *
176       +         ;*****************************************************************
177       +
178       +
179   F600+=        HSTBUF  EQU     0F600H          ;LENGTH 400H
180   FA00+=        DIRBUF  EQU     HSTBUF+400H     ;LENGTH 128
181   FA80+=        ALV0    EQU     DIRBUF+128      ;LENGTH 32
182   FAA0+=        CSV0    EQU     ALV0+32         ;LENGTH 64
183   FAE0+=        ALV1    EQU     CSV0+64         ;LENGTH 81
184   FB31+=        CSV1    EQU     ALV1+81         ;LENGTH 64
185   FB71+=        ALV2    EQU     CSV1+64         ;LENGTH 81
186   0000+=        CSV2    EQU     0               ;NOT USED FOR HARD DISK
187   FBC2+=        ALV3    EQU     ALV2+81         ;LENGTH 81
188   0000+=        CSV3    EQU     0               ;NOT USED FOR HARD DISK
189   FC13+=        ALV4    EQU     ALV3+81         ;LENGTH 81
190   0000+=        CSV4    EQU     0               ;NOT USED FOR HARD DISK
191   FC64+=        ALV5    EQU     ALV4+81         ;LENGTH 81
192   0000+=        CSV5    EQU     0               ;NOT USED FOR HARD DISK
193   FCB5+=        ALV6    EQU     ALV5+81         ;LENGTH 81
194   0000+=        CSV6    EQU     0               ;NOT USED FOR HARD DISK
195   FD06+=        ALV7    EQU     ALV6+81         ;LENGTH 81
196   0000+=        CSV7    EQU     0               ;NOT USED FOR HARD DISK
197   FD57+=        ALV8    EQU     ALV7+81         ;LENGTH 81
198   0000+=        CSV8    EQU     0               ;NOT USED FOR HARD DISK
199   FDA8+=        ALV9    EQU     ALV8+81         ;LENGTH 81
200   0000+=        CSV9    EQU     0               ;NOT USED FOR HARD DISK
201   FDF9+=        LINBUF  EQU     ALV9+81         ;LENGTH 160
202   FE99+=        DPB0    EQU     LINBUF+160      ;LENGTH 15
203   FEA8+=        DPB1    EQU     DPB0+15         ;LENGTH 15
204   FEB7+=        DPB2    EQU     DPB1+15         ;LENGTH 15
205   FEC6+=        DPB3    EQU     DPB2+15         ;LENGTH 15
206   FED5+=        DPB4    EQU     DPB3+15         ;LENGTH 15
207   FEE4+=        DPB5    EQU     DPB4+15         ;LENGTH 15
208   FEF3+=        DPB6    EQU     DPB5+15         ;LENGTH 15
209   FF02+=        DPB7    EQU     DPB6+15         ;LENGTH 15
210   FF11+=        DPB8    EQU     DPB7+15         ;LENGTH 15
211   FF20+=        DPB9    EQU     DPB8+15         ;LENGTH 15
212       +          ENDM
213                 DISKCEQU
214       +         ;*****************************************************************
215       +         ;*                                                               *
216       +         ;*              DISK CONTROLLER EQUATES 30.11.82 11:56 PH        *
217       +         ;*                                                               *
218       +         ;*****************************************************************
219       +
220       +
221   0051+=        DCOMD   EQU     00051H          ; DISK COMMAND PORT
222   0050+=        DSTAT   EQU     00050H          ; DISK STATUS PORT
223   0051+=        FDCRA   EQU     00051H          ; READ DATA FROM FDC
```

```
                        008     (PBIOS)

224       +             ;
225     0001+=          MOTOROFF        EQU     01H     ; MOTOR OFF INDICATOR (SYSSTA)
226       +             ;
227       +             ;
228     0010+=          RAMSEL  EQU     00010H          ; RAM SELECT
229     0011+=          ROMSEL  EQU     00011H          ; ROM SELECT
230     0012+=          SETTC   EQU     00012H          ; SET TC
231     0013+=          SYSSTA  EQU     00013H          ; SYSTEM STATUS PORT
232     0014+=          MOTORON EQU     00014H          ; MOTOR ON
233     0026+=          COAD    EQU     00026H          ; FDC DMA CHANNEL
234     0027+=          COTC    EQU     00027H          ; FDC DMA CHANNEL
235     0028+=          DMACOM  EQU     00028H          ; DMA COMMAND
236     0028+=          DMAST   EQU     00028H          ; READ DMA STATUS
237     0028+=          DMAMO   EQU     00028H
238     002A+=          DMAMB   EQU     0002AH
239       +
240     0004+=          DMAWRT  EQU     004H            ; DMA WRITE COMMAND
241     0008+=          DMAREAD EQU     008H            ; DMA READ COMMAND
242       +
243     0003+=          ENFD    EQU     003H            ; ENABLE FDC CHANNEL (CH3)
244     0007+=          DISFD   EQU     007H            ; DISABLE FDC CHANNEL (CH3)
245       +
246       +
247       +                     PAGE
```

```
248     +
249     +           ENDM
250             ;*****************************************************************
251             ;*****************************************************************
252             ;********                                              ********
253             ;********      BIOS DEVICE RQUTINES                    ********
254             ;********                                              ********
255             ;*****************************************************************
256             ;*****************************************************************
257             ;*****************************************************************
258             ;*                                                               *
259             ;*      CINIT  SET I/O BYTE                                      *
260             ;*             GET COUNTRY CODE FROM KDB                         *
261             ;*             INIT PRINTER                                      *
262             ;*                                                               *
263             ;*****************************************************************
264
265
266
267             CINIT:
268   0000 3A0000       LDA     IOBSET
269   0003 320300       STA     IOBYTE          ; SET INTEL I/O BYTE (ADDR 3)
270   0006 CD0000       CALL    KBDINIT         ; GET COUNTRY CODE OF KBD
271   0009 CD0000       CALL    DESLCT          ; DESELECT DRIVE 1
272             ;
273             ;       GET MONO / COLOR INDICATOR FROM FIRMWARE
274             ;
275   000C D311         OUT     ROMSEL          ; ENABLE FIRMWARE
276   000E 3AF90F       LDA     FWVER+2         ; GET COLOR INDICATOR
277   0011 325407       STA     COLORI          ; SAVE IT
278   0014 D310         OUT     RAMSEL          ; ENABLE RAM
279             WINIT:
280   0016 210000       LXI     H,0
281   0019 220000       SHLD    SACTIVE         ; RESET PRINTER ACTIVE FLAG
282   001C 3A0300       LDA     IOBYTE          ; INIT PRINTER
283   001F 07           RLC
284   0020 07           RLC
285   0021 CD9800       CALL    ROUTE
286   0024 0000         DW      SIOINIT
287   0026 0000         DW      SIOINIT
288   0028 0000         DW      PIOINIT
289   002A 0000         DW      SIOINIT
290
291
292
293
294                     PAGE
```

```
                    010    (PBIOS)

295
296
297                 ;*****************************************************************
298                 ;*                                                               *
299                 ;*      CONST   GET CONSOLE STATUS                               *
300                 ;*                                                               *
301                 ;*****************************************************************
302
303
304                 CONST:
305   002C 3A0300           LDA     IOBYTE
306   002F CD9800           CALL    ROUTE
307   0032 0000             DW      SRLINST         ; TTY:
308   0034 0000             DW      KEYST           ; CRT:
309   0036 0000             DW      KEYST           ; CRT:
310   0038 0000             DW      SRLINST         ; TTY:
311
312
313                 ;*****************************************************************
314                 ;*                                                               *
315                 ;*      CONIN   GET CONSOLE CHARACTER                            *
316                 ;*                                                               *
317                 ;*****************************************************************
318
319
320
321                 CONIN:
322   003A 3A0300           LDA     IOBYTE
323   003D CD9800           CALL    ROUTE
324   0040 0000             DW      SRLIN           ; TTY:
325   0042 0000             DW      KEYIN           ; CRT:
326   0044 0000             DW      KEYIN           ; CRT:
327   0046 0000             DW      SRLIN           ; TTY:
328
329
330                 ;*****************************************************************
331                 ;*                                                               *
332                 ;*      CONOUT  OUTPUT CHARACTER TO CONSOLE                      *
333                 ;*                                                               *
334                 ;*****************************************************************
335
336
337
338                 CONOUT:
339   0048 3A0300           LDA     IOBYTE
340   004B CD9800           CALL    ROUTE
341   004E 0000             DW      SRLCOUT         ; TTY:
342   0050 A700             DW      CRTOUT          ; CRT:
343   0052 A700             DW      CRTOUT          ; CRT:
344   0054 0000             DW      SRLCOUT         ; TTY:
345
346                         PAGE
```

```
                ;*****************************************************************
                ;*                                                               *
                ;*      PUNCH   OUTPUT CHARACTER TO THE PUNCH DEVICE             *
                ;*                                                               *
                ;*****************************************************************


0056 3A0300     PUNCH:  LDA     IOBYTE
0059 0F                 RRC
005A 0F                 RRC
005B 0F                 RRC
005C 0F                 RRC
005D CD9800             CALL    ROUTE
0060 0000               DW      SRLCOUT         ; TTY:
0062 A700               DW      CRTOUT          ; CRT:
0064 0000               DW      PRTOUT          ; LPT:
0066 A700               DW      CRTOUT          ; CRT:


                ;*****************************************************************
                ;*                                                               *
                ;*      READER  GET CHARACTER FROM READER DEVICE                 *
                ;*                                                               *
                ;*****************************************************************


                READER:
0068 3A0300             LDA     IOBYTE
006B 0F                 RRC
006C 0F                 RRC
006D CD9800             CALL    ROUTE
0070 0000               DW      SRLIN           ; TTY:
0072 0000               DW      KEYIN           ; CRT:
0074 0000               DW      KEYIN           ; CRT:
0076 0000               DW      SRLIN           ; TTY:


                        PAGE
```

```
                        012     (PBIOS)

391
392
393
394
395                     ;*****************************************************************
396                     ;*                                                               *
397                     ;*      LIST    OUTPUT CHARACTER TO LIST DEVICE                  *
398                     ;*                                                               *
399                     ;*****************************************************************
400
401
402
403                     LIST:
404
405   0078 3A0300               LDA     IOBYTE
406   0078 07                   RLC
407   007C 07                   RLC
408   007D CD9800               CALL    ROUTE
409   0080 0000                 DW      SRLOUT          ; TTY:
410   0082 A700                 DW      CRTOUT          ; CRT:
411   0084 0000                 DW      PRTOUT          ; LPT:
412   0086 0000                 DW      SRLOUT          ; TTY:
413
414
415
416                     ;*****************************************************************
417                     ;*                                                               *
418                     ;*      LISTST  GET STATUS FROM LIST DEVICE                      *
419                     ;*                                                               *
420                     ;*****************************************************************
421
422
423
424                     LISTST:
425   0088 3A0300               LDA     IOBYTE
426   0088 07                   RLC
427   008C 07                   RLC
428   0080 CD9800               CALL    ROUTE
429   0090 0000                 DW      SRLSTAT         ; TTY:
430   0092 0000                 DW      KEYST           ; CRT:
431   0094 0000                 DW      PRTSTAT         ; LPT:
432   0096 0000                 DW      SRLSTAT         ; TTY:
433
434                             PAGE
```

```
435
436
437                     ;*****************************************************************
438                     ;*                                                               *
439                     ;*      ROUTE   TRANSFER TO SELECTED PHYSICAL DEVICE             *
440                     ;*                                                               *
441                     ;*                                                               *
442                     ;*****************************************************************
443
444
445                     ROUTE:
446   0098 E603                 ANI     3               ; MASK BIT 0 AND 1
447   009A 87                   ADD     A               ; 2 BYTE OFFSET
448   009B E1                   POP     H               ; HL - START ADDRESS OF TABLE
449   009C 85                   ADD     L
450   009D 6F                   MOV     L,A
451   009E D2A200               JNC     ROUT1
452   00A1 24                   INR     H
453                     ROUT1:
454   00A2 7E                   MOV     A,M             ;HL - ENTRY ADDRESS IN TABLE
455   00A3 23                   INX     H
456   00A4 66                   MOV     H,M
457   00A5 6F                   MOV     L,A
458   00A6 E9                   PCHL                    ; TRANSFER TO SELECTED PHYSICAL DRIVER
459
460                             PAGE
```

```
                        ;*****************************************************************
                        ;*****************************************************************
                        ;********                                             ********
                        ;********              CRT DRIVER                     ********
                        ;********                                             ********
                        ;*****************************************************************
                        ;*****************************************************************
                        ;*****************************************************************
                        ;*                                                               *
                        ;*                    CRT EQUATES                                *
                        ;*                                                               *
                        ;*****************************************************************


                        GDCEQU
                    +   ;               'GDC-EQUATES' 27/10/82 10:00 WF
                    +   ;                ============================
                    +   ;
                    +   ;       READ
00A0+=              GDCSTA  EQU     0A0H            ;STATUS PORT
00A1+=              FIFO    EQU     0A1H            ;GDC FIFO PORT ADDR
                    +   ;
                    +   ;
                    +   ;       WRITE
00A0+=              GDCPAR  EQU     0A0H            ;PARAMETER INTO FIFO
00A1+=              GDCCOM  EQU     0A1H            ;COMMAND INTO FIFO
                    +   ;
                    +   ;
                    +   ;       ORGNNISATION OF GRAPHIC RAM
                    +   ;
                    +   ;       576 X 400  PIXELS
                    +   ;
1FFF+=              GRAEND  EQU     1FFFH           ;END ADDRESS OF GRAPHIC RAM
0048+=              NRWAPL  EQU     72              ;NUMBER OF WORD ADDR PER LINE
0024+=              WPL     EQU     NRWAPL/2        ;WORDS / LINE
000A+=              LPC     EQU     10              ;LINES / CHARACTER
                    +   ;
                    +   ;       MEANING OF GDC STATUS BITS
                    +   ;
0001+=              DATRDY  EQU     01H             ;A BYTE IS AVAILABLE TO READ
0002+=              FIFULL  EQU     02H             ;FIFO IS FULL
0004+=              FIFEMP  EQU     04H             ;FIFO IS EMPTY
0008+=              DRWINP  EQU     08H             ;DRAWING IN PROCESS
0010+=              DMAEXC  EQU     10H             ;DMA DATA TRANSFER IN PROCESS
0020+=              VERETR  EQU     20H             ;VERTICAL RETRACE IN PROCESS
0040+=              HORETR  EQU     40H             ;HORIZONTAL RETRACE IN PROCESS
0080+=              LIPDET  EQU     80H             ;LIGHT PEN DETECT (ADDRESS VALID)
                    +   ;
                    +   ;
                    +   ;       COMMANDS
                    +   ;
0000+=              GDCRES  EQU     0               ;RESET - BLANK DISPLAY, IDLE MODE, INITIALIZE
006E+=              VSYNCS  EQU     06EH            ;SLAVE MODE
```

```
                ;
PRAM    EQU     0704H           ;LOAD PARAMETER RAM
PRAMSA  EQU     0               ;LOWER 4 BITS ARE STARTING ADDRESS IN RAM
                                ;( COMMAND + SA )
                ;
WDAT    EQU     020H            ;WRITE DATA INTO DISPLAY MEMORY
                                ;( COMMAND + TYPE + MODE )
                                ;DATA TRANSFER TYPES
TYWORD  EQU     0               ;WORD, LOW THEN HIGH BYTE
TYLOBY  EQU     010H            ;LOW BYTE OF THE WORD
TYHIBY  EQU     018H            ;HIGH BYTE OF THE WORD
                                ;MODE OF RMW MEMORY CYCLE
MOREPL  EQU     0               ;REPLACE WITH PATTERN
MOCOMP  EQU     01H             ;COMPLEMENT
MORES   EQU     02H             ;RESET TO 0
MOSET   EQU     03H             ;SET TO 1
                ;
RDAT    EQU     0A0H            ;READ DATA FROM DISPLAY MEMORY
                                ;( COMMAND + TYPE )
                                ;TYPES AS AT WDAT
                ;
DMAR    EQU     0A4H            ;DMA READ REQUEST
                                ;( COMMAND + TYPE )
                                ;TYPES AS AT WDAT
                ;
DMAW    EQU     024H            ;DMA WRITE REQUEST
                                ;( COMMAND + TYPE + MODE )
                                ;TYPES AND MODES AS AT WDAT
                ;
                ;       PARAMETERS
                ;
                ;       RESET
                ;
RESMOP  EQU     0               ;MODE OF OPERATION SELECT BITS
                                ;( RESMOP + DISPLAY + FRAME + DYNRAM + WINDOW )
                                ;DISPLAY MODE
MIXGAC  EQU     0H              ;MIXED GRAPHICS & CHARACTER
GRAMOD  EQU     02H             ;GRAPHICS MODE
CHAMOD  EQU     020H            ;CHARACTER MODE
                                ;VIDEO FRAMING
NOINTL  EQU     0               ;NON-INTERLACED
INLRPF  EQU     08H             ;INTERLACED REPEAT FIELD FOR CHARACTER DISPLAYS
INTLAC  EQU     09H             ;INTERLACED
                                ;DYNAMIC RAM REFRESH CYCLES ENABLE
```

```
                        016     (PBIOS)

573   0000+=            SATRM   EQU     0               ;NO REFRESH - STATIC RAM
574   0004+=            DYNRAM  EQU     04H             ;REFRESH - DYNAMIC RAM
575      +                                              ;DRAWING TIME WINDOW
576   0000+=            DRWALL  EQU     0               ;DRAWING DURING ACTIVE DISPLAY TIME AND RETRACE
577   0010+=            DRWRET  EQU     010H            ;DRAWING ONLY DURING RETRACE BLANKING
578      +              ;
579   0050+=            LWID    EQU     80              ;CHARACTERS / LINE
580   0018+=            LINES   EQU     24              ;LINES / SCREEN
581      +                      PAGE
```

```
582       +
583       +                 EMDM
584
585                 ;*****************************************************************
586                 ;*                                                               *
587                 ;*      CRTOUT          CRT DRIVER                               *
588                 ;*                                                               *
589                 ;*****************************************************************
590
591
592   00A7 C5       CRTOUT: PUSH    B               ;SAVE REGISTER
593   00A8 D5               PUSH    D
594   00A9 E5               PUSH    H
595   00AA 3A4D07           LDA     ESCFLG          ;
596   00AD B7               ORA     A               ; DO ESCAPE SEQUENCE
597   00AE C2D302           JNZ     ESCAPE          ;
598   00B1 3A4C07           LDA     DRQ             ;
599   00B4 B7               ORA     A               ;
600   00B5 CABC00           JZ      VID1            ; JUMP IF NO DATA REQUEST
601   00B8 2A4E07           LHLD    DRQADR          ;
602   00BB E9               PCHL                    ; GO TO DATA REQUESTING ROUTINE
603
604
605   00BC 79       VID1:   MOV     A,C             ; CHARACTER --) A
606   00BD E67F             ANI     07FH            ; NO DISPLAY OF CHARACTERS ) 7FH
607   00BF FE20             CPI     ' '             ;
608   00C1 DA8E02           JC      FINDCH          ; JUMP IF CONTROL CHR
609                 PUTCHR:
610   00C4 CDA802           CALL    TRNCHR          ; CHARACTER TRANSLATION
611   00C7 79               MOV     A,C             ; GET CHARACTER
612   00C8 CD0200           CALL    MODCRT          ; DISPLAY CHARACTER
613   00CB CD6502           CALL    NXTCUR          ; NEXT CURSOR POSITION
614
615                 POPREG:
616                 ;
617   00CE E1               POP     H               ; RESTORE REGISTER
618   00CF D1               POP     D               ;
619   00D0 C1               POP     B               ;
620   00D1 C9               RET                     ; RETURN
621                         PAGE
```

```
                    018    (FBIOS)

622
623
624                 ;*****************************************************************
625                 ;*                                                               *
626                 ;*   MODCRT    PLACE CHARACTER INTO GDC-MEMORY                   *
627                 ;*                   A - CHARACTER TO TRANSFER                   *
628                 ;*                                                               *
629                 ;*****************************************************************
630                 ;
631                 ;
632                 MODCRT:
633  0002 F5                PUSH    PSW             ; SAVE CHARACTER
634  0003 3A4607            LDA     CURCOL
635  0006 FE50              CPI     LWID
636                                                    ; SCROLL WHOLE SCREEN
637  0008 CC5106            CZ      SCLUP4          ; SCROLL IF COLUMN = LWID
638  000B F1                POP     PSW             ; GET CHARACTER
639  000C 5F                MOV     E,A
640  000D 3A5007            LDA     INVFLG          ;GET ATTRIBUTE
641  00E0 57                MOV     D,A
642  00E1 CDE500            CALL    WRGCHR          ; WRITE CHARACTER
643  00E4 C9                RET
644                         PAGE
```

```
                                ;       GDCMIX
                                ;       GDC DRIVER FOR MIXED MODE 20/01/83 12:30 WF
                                ;
                                ;       WRITE ONE CHARACTER IN MIXED MODE
                                ;       ENTRY REGISTER:
                                ;                       D = ATTRIBUTE
                                ;                       E = CHARACTER
                                ;
                                WRGCHR:
00E5+3E20       1               MVI     A,WDAT OR TYWORD OR MOREFL
00E7+CD0C07     1               CALL    OUTCMD
00EA+7B         1               MOV     A,E             ;OUTPUT CHARACTER
00EB+CD1207     1               CALL    OUTPAR
00EE+7A         1               MOV     A,D             ;OUTPUT ATTRIBUTE
00EF+CD1207     1               CALL    OUTPAR
00F2+C9         1               RET
                                ;
                                ;       READ ONE CHARACTER FROM GDC IN MIXED MODE
                                ;
                                ;       EXIT REGISTERS:
                                ;                       D = ATTRIBUTE
                                ;                       E = CHARACTER
                                RDGCHR:
00F3+3E4C       1               MVI     A,FIGS          ;FIGS COMMAND
00F5+CD0C07     1               CALL    OUTCMD
00F8+3E02       1               MVI     A,2             ;DIRECTION = 2
00FA+CD1207     1               CALL    OUTPAR
00FD+3E01       1               MVI     A,1             ;DC = 1
00FF+CD1207     1               CALL    OUTPAR
0102+AF         1               XRA     A               ;
0103+CD1207     1               CALL    OUTPAR
0106+3EA0       1               MVI     A,RDAT OR TYWORD
0108+CD0C07     1               CALL    OUTCMD
010B+CD2C07     1               CALL    INPAR           ;GET ASCII CHARACTER
010E+5F         1               MOV     E,A
010F+CD2C07     1               CALL    INPAR           ;GET ATTRIBUTE
0112+57         1               MOV     D,A
0113+C9         1               RET
                                ;
                                ;
                                SPCLEAR1:
0114+D5         1               PUSH    D
0115+09         1               DAD     B               ;TEST IF LENGTH OUT OF RANGE
0116+11D007     1               LXI     D,07D0H
0119+CD0000     1               CALL    COMPDEHL
011C+D1         1               POP     D
011D+DA3601     1               JC      SPCLEAR2        ;IN RANGE
0120+CA3601     1               JZ      SPCLEAR2
0123+D5         1               PUSH    D
0124+11D007     1               LXI     D,7D0H
0127+CD0000     1               CALL    SUBHLDE
012A+D1         1               POP     D
012B+CD3601     1               CALL    SPCLEAR2
012E+44         1               MOV     B,H
012F+4D         1               MOV     C,L
```

```
                    020    (PBIOS)

701   0130+210000   1      LXI     H,0
702   0133+CD7001   1      CALL    SETCUR1          ;CLEAR REST
703      +          SPCLEAR2:
704   0136+0B       1      DCX     B
705   0137+CD8701   1      CALL    SETMSK
706   013A+3E4C     1      MVI     A,FIGS
707   013C+CD0C07   1      CALL    OUTCMD
708   013F+3E02     1      MVI     A,2
709   0141+CD1207   1      CALL    OUTPAR
710   0144+79       1      MOV     A,C
711   0145+CD1207   1      CALL    OUTPAR
712   0148+78       1      MOV     A,B
713   0149+CD1207   1      CALL    OUTPAR
714   014C+3E20     1      MVI     A,WDAT OR TYWORD OR MOREPL
715   014E+CD0C07   1      CALL    OUTCMD
716   0151+7B       1      MOV     A,E
717   0152+CD1207   1      CALL    OUTPAR
718   0155+3A5007   1      LDA     INVFLG                ;GET INVERSE FLAG
719   0158+CD1207   1      CALL    OUTPAR
720   015B+C9       1      RET
721      +                 PAGE
```

```
722       +
723       +         ;
724       +         ;       SET CURSOR
725       +         ;       ENTRY REGISTER:
726       +         ;                       HL = GDC CURSOR POSITION
727       +         ;
728       +         SETCUR:
729   015C+D5       1       PUSH    D
730   015D+E5       1       PUSH    H
731   015E+2A5D02   1       LHLD    SP1
732   0161+D1       1       POP     D               ;CORRECR CURSOR POSITION
733   0162+19       1       DAD     D
734   0163+110007   1       LXI     D,0700H
735   0166+CD0000   1       CALL    COMPDEHL        ;TEST IF OVERFLOW
736   0169+DA6F01   1       JC      SETCUR2         ;NOT OVERFLOW
737   016C+CD0000   1       CALL    SUBHLDE
738       +         SETCUR2:
739   016F+D1       1       POP     D
740       +         SETCUR1:
741   0170+D5       1       PUSH    D
742   0171+3E49     1       MVI     A,CURS          ;CURSOR COMMAND
743   0173+CD0C07   1       CALL    OUTCMD
744   0176+7D       1       MOV     A,L             ;CURSOR POSITION LOW
745   0177+CD1207   1       CALL    OUTPAR
746   017A+7C       1       MOV     A,H             ;CURSOR POSITION HIGH
747   017B+CD1207   1       CALL    OUTPAR
748   017E+AF       1       XRA     A
749   017F+CD1207   1       CALL    OUTPAR
750   0182+CD8701   1       CALL    SETMSK          ;SET MASK
751   0185+D1       1       POP     D
752   0186+C9       1       RET
753       +         ;
754       +         ;
755       +         ;       SET MASK
756       +         ;
757       +         SETMSK:
758   0187+3E4A     1       MVI     A,MASK
759   0189+CD0C07   1       CALL    OUTCMD
760   018C+3EFF     1       MVI     A,-1
761   018E+CD1207   1       CALL    OUTPAR
762   0191+CD1207   1       CALL    OUTPAR
763   0194+C9       1       RET
764       +         ;
765       +         ;
766       +         ROLIN:
767   0195+E5       1       PUSH    H
768   0196+C5       1       PUSH    B
769   0197+3E4C     1       MVI     A,FIGS          ;FIGS COMMAND
770   0199+CD0C07   1       CALL    OUTCMD
771   019C+3E02     1       MVI     A,2             ;DIRECTION = 2
772   019E+CD1207   1       CALL    OUTPAR
773   01A1+3E50     1       MVI     A,80            ;LENGTH = 80 WORDS
774   01A3+CD1207   1       CALL    OUTPAR
775   01A6+AF       1       XRA     A
776   01A7+CD1207   1       CALL    OUTPAR
777   01AA+3EA0     1       MVI     A,ROAT          ;READ INTO BUFFER
```

```
                        022     (PBIOS)

778   01AC+CD0C07       1       CALL    OUTCMD
779   01AF+21F9FD       1       LXI     H,LINBUF        ;BUFFER ADDRESS
780   01B2+06A0         1       MVI     B,160           ;NUMBER OF BYTES
781       +             RDLIN1:
782   01B4+CD2C07       1       CALL    INPAR           ;GET CHARACTER
783   01B7+77           1       MOV     M,A
784   01B8+23           1       INX     H
785   01B9+05           1       DCR     B
786   01BA+C2B401       1       JNZ     RDLIN1
787   01BD+C1           1       POP     B
788   01BE+E1           1       POP     H
789   01BF+C9           1       RET
790       +             ;
791       +             ;
792       +             ;
793       +             WRLIN:
794   01C0+E5           1       PUSH    H
795   01C1+C5           1       PUSH    B
796   01C2+3E4C         1       MVI     A,FIGS          ;FIGS COMMAND
797   01C4+CD0C07       1       CALL    OUTCMD
798   01C7+3E02         1       MVI     A,2             ;DIRECTION = 2
799   01C9+CD1207       1       CALL    OUTPAR
800   01CC+AF           1       XRA     A               ;DC = 0
801   01CD+CD1207       1       CALL    OUTPAR
802   01D0+CD1207       1       CALL    OUTPAR
803   01D3+3E20         1       MVI     A,WDAT OR TYWORD OR MOREPL
804   01D5+CD0C07       1       CALL    OUTCMD
805   01D8+21F9FD       1       LXI     H,LINBUF        ;START ADDRESS OF BUFFER
806   01DB+06A0         1       MVI     B,160           ;LENGTH
807       +             WRLIN1:
808   01DD+7E           1       MOV     A,M             ;GET CHARACTER FROM BUFFER
809   01DE+CD1207       1       CALL    OUTPAR
810   01E1+23           1       INX     H
811   01E2+05           1       DCR     B
812   01E3+C2DD01       1       JNZ     WRLIN1
813   01E6+C1           1       POP     B
814   01E7+E1           1       POP     H
815   01E8+C9           1       RET
816       +             ;
817       +             INIT10:
818   01E9+F5           1       PUSH    PSW
819   01EA+210000       1       LXI     H,0
820   01ED+225002       1       SHLD    SP1             ;START OF PAGE 1 = 0
821   01F0+226102       1       SHLD    SP2             ;START OF PAGE 2 = 0
822   01F3+AF           1       XRA     A
823       +                                             ;LENGTH OF PAGE 2 = 0
824   01F4+326402       1       STA     LP22
825   01F7+3E19         1       MVI     A,25            ;LENGTH OF PAGE 1 = 25
826   01F9+326002       1       STA     LP12
827   01FC+3E4C         1       MVI     A,FIGS
828   01FE+CD0C07       1       CALL    OUTCMD
829   0201+3E02         1       MVI     A,2
830   0203+CD1207       1       CALL    OUTPAR
831   0206+F1           1       POP     PSW
832   0207+C9           1       RET
833       +             ;
```

```
                        023    (P8IOS)

834       +             ;
835       +             ;
836       +             ;
837       +             CUROFF:
838   0208+3E4B         1         MVI     A,CCHAR
839   020A+CD0C07       1         CALL    OUTCMD
840   020D+3E0F         1         MVI     A,0FH
841   020F+CD1207       1         CALL    OUTPAR          ;CURSOR OFF
842   0212+C9           1         RET
843       +             ;
844       +             ;
845       +             CURON:
846   0213+3E4B         1         MVI     A,CCHAR         ;CURSOR ON
847   0215+CD0C07       1         CALL    OUTCMD
848   0218+3E8F         1         MVI     A,8FH
849   021A+CD1207       1         CALL    OUTPAR
850   021D+3ECE         1         MVI     A,0CEH
851   021F+CD1207       1         CALL    OUTPAR
852   0222+3E72         1         MVI     A,72H
853   0224+CD1207       1         CALL    OUTPAR
854   0227+C9           1         RET
855       +             ;
856       +             ;
857       +             SCROLL:
858   0228+210000       1         LXI     H,0             ;GET START OF PAGE 1
859   022B+015000       1         LXI     B,80
860   022E+CD0E06       1         CALL    CLEARSP         ;CLEAR TOP LINE
861   0231+2A5D02       1         LHLD    SP1
862   0234+115000       1         LXI     D,80            ;START OF PAGE 1 + ONE LINE
863   0237+19           1         DAD     D
864   0238+225D02       1         SHLD    SP1
865   023B+3A6002       1         LDA     LP12            ;LENGTH OF PAGE 1 - 1
866   023E+3D           1         DCR     A
867   023F+CCE901       1         CZ      INIT10          ;IF LENGTH = 0 INIT ONCE MORE
868   0242+CA4F02       1         JZ      SCROL1
869   0245+326002       1         STA     LP12
870   0248+3A6402       1         LDA     LP22            ;LENGTH OF PAGE 2 + 1
871   024B+3C           1         INR     A
872   024C+326402       1         STA     LP22
873       +             SCROL1:
874   024F+3E70         1         MVI     A,PRAM+0        ;INITIALIZE PAGES
875   0251+CD0C07       1         CALL    OUTCMD
876   0254+0608         1         MVI     B,8
877   0256+215D02       1         LXI     H,SP1
878   0259+CD3207       1         CALL    SENPAR
879   025C+C9           1         RET
880       +             ;
881       +             ;
882   025D+0000         SP1:      DW      0               ;START OF PAGE 1
883   025F+00           LP11:     DB      0               ;LENGTH OF PAGE 1 LOW
884   0260+00           LP12:     DB      0               ;LENGTH OF PAGE 1 HIGH
885   0261+0000         SP2:      DW      0               ;START OF PAGE 2
886   0263+00           LP21:     DB      0               ;LENGTH OF PAGE 2 LOW
887   0264+00           LP22:     DB      0               ;LENGTH OF PAGE 2 HIGH
888       +             ;
889       +             ;


                        +024   (P8IOS)

890       +                    PAGE
```

```
                    025    (PBIOS)

891       +
892       +                ENDM
893
894                 ;*****************************************************************
895                 ;*                                                               *
896                 ;*      NXTCUR  NEXT CURSOR POSITION                             *
897                 ;*                                                               *
898                 ;*****************************************************************
899
900
901                 NXTCUR:
902   0265 3A4607           LDA     CURCOL          ; GET CURRENT COLUMN NUMBER
903   0268 3C               INR     A               ; COLUMN +1
904   0269 FE50             CPI     LWID            ; IF CURRENT COLUMN + 1 = WIDTH
905   026B D27202           JNC     NXTCR1          ; THEN JUMP
906   026E 324607           STA     CURCOL          ; SAVE NEW COLUMN
907   0271 C9               RET
908
909
910                 NXTCR1:
911   0272 3A4707           LDA     CURROW          ; GET CURRENT ROW
912   0275 FE17             CPI     LINES-1         ; IF ON LAST ROW
913   0277 C27F02           JNZ     NXTCR2          ; "JUMP IF NOT ON LAST ROW"
914   027A 214607           LXI     H,CURCOL
915   027D 34               INR     M               ; INDICATE COLUMN FOR SCROLLING
916   027E C9               RET
917
918
919   027F AF         NXTCR2: XRA     A               ; SET
920   0280 324607           STA     CURCOL          ; COLUMN TO ZERO
921   0283 3A4707           LDA     CURROW
922   0286 3C               INR     A               ; ROW = ROW +1
923   0287 324707           STA     CURROW
924   028A CDED06           CALL    WRCUP0  ;SET CURSOR
925   028D C9               RET
926
927
928                 PAGE
```

```
                        ;*****************************************************************
                        ;*                                                               *
                        ;*     FINDCH  SEARCH CHARACTER IN CONTROL CHARACTER TABLE       *
                        ;*                                                               *
                        ;*****************************************************************


                        FINDCH:
028E 2A4A07                     LHLD    CURPOS          ; CURSOR POSITION TO TOP OF STACK
0291 E5                         PUSH    H               ;
0292 21EA02                     LXI     H,COMTBL        ; POINTER TO COMMAND TABLE
                        ;
                        ;
                        ;       GO TO FIND ROUTINE
                        ;
                        ;

                                PAGE
```



```
                        ;*****************************************************************
                        ;*                                                               *
                        ;*     FINDAD  TRANSFER CONTROL TO A SELECTED                    *
                        ;*             ROUTINE                                           *
                        ;*                                                               *
                        ;*                                                               *
                        ;*****************************************************************


                        FINDAD:
0295 BE                         CMP     M               ; CHARACTER FOUND
0296 CAA402                     JZ      LOOKE           ; JUMP IF CHR FOUND
0299 46                         MOV     B,M             ; MOVE CHARACTER FROM TABLE --) B
029A 04                         INR     B               ; TEST FOR LAST CHARACTER
029B CAA402                     JZ      LOOKE           ; JUMP AT END
029E 23                         INX     H
029F 23                         INX     H
02A0 23                         INX     H               ; NEXT ENTRY
02A1 C39502                     JMP     FINDAD          ;
                        LOOKE:
02A4 23                         INX     H               ; GET ADDRESS --) HL
02A5 5E                         MOV     E,M
02A6 23                         INX     H
02A7 56                         MOV     D,M
02A8 EB                         XCHG                    ;
02A9 E3                         XTHL                    ; PUT ADDRESS TO TOP OF STACK
02AA C9                         RET                     ; GO TO IT


                                PAGE
```

```
                        028    (PBIOS)

                        ;*****************************************************************
                        ;*                                                               *
                        ;*      TRNCHR  TRANSLATE CHARACTER ACCORDING TO THE LANGUAGE    *
                        ;*              CODE OF THE KBD (IF REQUIRED)                    *
                        ;*              ENTER WITH CHAR IN [C]                           *
                        ;*              EXIT WITH TRANSLATEDCHARACTER IN [C]             *
                        ;*                                                               *
                        ;*****************************************************************


                        TRNCHR:
02AB 3A0000                     LDA     TRANS
02AE B7                         ORA     A
02AF C2C802                     JNZ     TRNCHR2         ; JUMP IF HEBREW TRANSLATION REQUIRED
                        TRNSPC:
02B2 3A0000                     LDA     LANGUAGE        ; GET LANGUAGE CODE
                        ;
                        ; FIND TRANSLATION TABLE ADDRESS
                        ;
0285 210000                     LXI     H,CRTTBL
0288 CD0000                     CALL    GETLPOS         ; GET ADDRESS OF TRANSLATION TABLE
0288 46                         MOV     B,M             ; B - LENGTH OF SPEC. TRANSLATION ENTRY
                        ;
                        ;
                        ; TRANSLATE IF REQUIRED
                        ;
                        TRNCHR1:
028C 05                         DCR     B               ; DECREMENT LENGTH
028D 23                         INX     H
028E 7E                         MOV     A,M             ; GET CHARACTER
028F C8                         RZ                      ; RETURN IF NO TRANSLATION REQ.
02C0 05                         DCR     B               ; DECREMENT LENGTH
02C1 B9                         CMP     C
02C2 23                         INX     H
02C3 C2BC02                     JNZ     TRNCHR1         ; JUMP IF NOT =
02C6 4E                         MOV     C,M             ; TRANSLATED CHAR. -> C
02C7 C9                         RET

                        TRNCHR2:
02C8 79                         MOV     A,C
02C9 FE60                       CPI     60H
02CB D8                         RC                      ; RETURN IF NO TRANSLATION REQUIRED
02CC FE7B                       CPI     7BH
02CE D0                         RNC                     ; RETURN IF NO TRANSLATION REQUIRED
02CF E61F                       ANI     01FH            ; TRANSLATE 60H-7AH -> 00H-1AH
02D1 4F                         MOV     C,A             ; CHARACTER -> C
02D2 C9                         RET


                                PAGE
```

```
1034
1035                    ;*****************************************************************
1036                    ;*                                                               *
1037                    ;*      ESCAPE  ESCAPE HANDLING                                  *
1038                    ;*              A - CONTROL CHARACTER                            *
1039                    ;*                                                               *
1040                    ;*****************************************************************
1041
1042
1043
1044
1045  0203 AF       ESCAPE: XRA     A               ;
1046  0204 324D07           STA     ESCFLG          ; RESET ESCAPE FLAG
1047  0207 79               MOV     A,C             ;
1048  0208 2A4A07           LHLD    CURPOS          ;
1049  020B E5               PUSH    H               ; DUMMY PUSH
1050  020C 210803           LXI     H,ESCTBL        ; ESCAPE TABLE
1051  020F C39502           JMP     FINDAD          ; SEARCH THE CORRECT ESCAPE SEQUENCE
1052
1053
1054
1055
1056
1057  02E2 3EFF     SETESC: MVI     A,0FFH          ; SET ESCAPE FLAG
1058  02E4 324D07           STA     ESCFLG
1059  02E7 C3CE00           JMP     POPREG
1060
1061
1062
1063                        PAGE
```

```
                        030    (PBIOS)

1064
1065                    ;*****************************************************************
1066                    ;*                                                               *
1067                    ;*      COMTBL  SINGLE BYTE CRT CONTROL FUNCTIONS                *
1068                    ;*                                                               *
1069                    ;*****************************************************************
1070
1071
1072                    COMTBL:
1073   02EA 07                  DB      07H
1074   02EB 3304                DW      BELL    ; RING THE BELL
1075   02ED 08                  DB      08H
1076   02EE 5F05                DW      BACKSP  ; NON DESTRUCTIVE BACKWARD SPACE
1077   02F0 0A                  DB      0AH
1078   02F1 5305                DW      LINEFD  ; LINE FEED
1079   02F3 0B                  DB      0BH
1080   02F4 8305                DW      RLFEED  ; REVERSE LINE FEED
1081   02F6 0C                  DB      0CH
1082   02F7 2805                DW      FSPACE  ; NON DESTRUCTIVE FORWARD SPACE
1083   02F9 0D                  DB      0DH
1084   02FA 5905                DW      CARRET  ; CARRIAGE RETURN
1085   02FC 17                  DB      17H
1086   02FD 2205                DW      EREOL   ; ERASE TO END OF LINE
1087   02FF 1A                  DB      1AH
1088   0300 A305                DW      CLEAR   ; CLEAR SCREEN
1089   0302 1B                  DB      1BH
1090   0303 E202                DW      SETESC  ; ESCAPE SEQUENCES
1091   0305 1E                  DB      1EH
1092   0306 9305                DW      CURHOM  ; HOME CURSOR
1093   0308 FF                  DB      0FFH    ; END OF TABLE
1094   0309 CE00                DW      POPREG  ; DO NOTHING ROUTINE
1095
1096
1097                    PAGE
```

```
1098
1099
1100                    ;*****************************************************************
1101                    ;*                                                               *
1102                    ;*      ESCTBL  TABLE OF IMPLEMENTED ESCAPE FUNCTIONS            *
1103                    ;*                                                               *
1104                    ;*****************************************************************
1105
1106
1107
1108  0308 2A           ESCTBL: DB      2AH
1109  030C A305                 DW      CLEAR           ; CLEAR SCREEN
1110  030E 3A           DB      3AH
1111  030F A305         DW      CLEAR           ; CLEAR SCREEN
1112  0311 29           DB      29H
1113  0312 7B03         DW      HALFSET         ; SET HALF INTENSITY
1114  0314 28           DB      28H
1115  0315 9103         DW      HALFRES         ; RESET HALF INTENSITY
1116  0317 59           DB      'Y'
1117  0318 BE05         DW      CLREOS          ; ERASE TO END OF SCREEN
1118  031A 79           DB      'y'
1119  031B BE05         DW      CLREOS          ; ERASE TO END OF SCREEN
1120  031D 54           DB      'T'
1121  031E 2205         DW      EREOL           ; ERASE TO END OF LINE
1122  0320 74           DB      't'
1123  0321 2205         DW      EREOL           ; ERASE TO END OF LINE
1124  0323 45           DB      'E'
1125  0324 7904         DW      INLINE          ; INSERT LINE
1126  0326 52           DB      'R'
1127  0327 8204         DW      DELINE          ; DELETE LINE
1128  0329 51           DB      'Q'
1129  032A 8804         DW      INCHAR          ; INSERT CHARACTER
1130  032C 57           DB      'W'
1131  032D DA04         DW      DECHAR          ; DELETE CHARACTER
1132  032F 3D           DB      '='
1133  0330 3E03         DW      POSCUR          ; POSITION CURSOR
1134  0332 4D           DB      'M'
1135  0333 4E04         DW      MUSIC           ; MUSIC
1136  0335 46           DB      'F'
1137  0336 0000         DW      FUNCCH          ; CHANGE FUNCTION
1138  0338 47           DB      'G'
1139  0339 A703         DW      REVERSE         ; INVERSE VIDEO
1140  033B FF           DB      0FFH
1141  033C CE00         DW      POPREG
1142
1143
1144
1145                    PAGE
```

```
                    032    (PBIOS)

1146
1147                ;*****************************************************************
1148                ;*                                                               *
1149                ;*      POSCUR  POSITION CURSOR                                  *
1150                ;*                                                               *
1151                ;*****************************************************************
1152
1153
1154                POSCUR:
1155  033E 3EFF             MVI     A,0FFH          ; SET
1156  0340 324C07           STA     DRQ             ; DATA REQUEST FLAG
1157  0343 214C03           LXI     H,GETY          ;
1158  0346 224E07           SHLD    CRQADR          ; SET DRQ ADDRESS
1159  0349 C3CE00           JMP     POPREG          ; RETURN
1160
1161
1162                GETY:
1163  034C 79               MOV     A,C             ; GET Y-POSITION
1164  034D D620             SUI     ' '             ; SUBTRACT 20H
1165  034F FE19             CPI     25
1166  0351 D25703           JNC     GETY1           ; JUMP IF OUT OF RANGE
1167  0354 325307           STA     YPOS            ; SAVE Y-POSITION
1168                GETY1:
1169  0357 216003           LXI     H,GETX          ;
1170  035A 224E07           SHLD    DRQADR          ; NEXT DRQ ADDRESS
1171  035D C3CE00           JMP     POPREG
1172
1173
1174  0360 79         GETX: MOV     A,C             ; GET X-POSITION
1175  0361 D620             SUI     ' '             ; SUBTRACT 20H
1176  0363 FE50             CPI     80
1177  0365 D26B03           JNC     GETX1           ; JUMP IF OUT OF RANGE
1178  0368 324607           STA     CURCOL          ; SAVE X POSITION
1179                GETX1:
1180  0368 AF               XRA     A               ; CLEAR
1181  036C 324C07           STA     DRQ             ; DATA REQUEST FLAG
1182  036F 3A5307           LDA     YPOS            ; GET Y-POSITION
1183  0372 324707           STA     CURROW          ; SET Y-POS
1184  0375 CDED06           CALL    WRCUPO
1185  0378 C3CE00           JMP     POPREG          ;
1186
1187
1188
1189                PAGE
```

```
1190
1191                    ;*****************************************************************
1192                    ;*                                                               *
1193                    ;*  HALFSET   SET FLAG FOR HALF INTENSITY                        *
1194                    ;*                                                               *
1195                    ;*****************************************************************
1196
1197
1198                    HALFSET:
1199  0378 0604                 MVI     B,4
1200  037D 3A5407               LDA     COLORI          ; GET COLOR INDEX
1201  0380 FE43                 CPI     'C'
1202  0382 C28703               JNZ     INVS1           ; JUMP IF MONOCHROM
1203  0385 0605                 MVI     B,5
1204                    INVS1:
1205  0387 3A5007               LDA     INVFLG          ; GET ATTRIBUTE BYTE
1206  038A B0                   ORA     B               ; SET HALF INTENSITY
1207  038B 325007               STA     INVFLG          ; SET HALF INTENSITY FLAG
1208  038E C3CE00               JMP     POPREG
1209
1210
1211
1212                    ;*****************************************************************
1213                    ;*                                                               *
1214                    ;*  HALFRES   RESET HALF INTENSITY                               *
1215                    ;*                                                               *
1216                    ;*****************************************************************
1217
1218                    HALFRES:
1219  0391 06FB                 MVI     B,0FBH
1220  0393 3A5407               LDA     COLORI          ; GET COLOR INDEX
1221  0396 FE43                 CPI     'C'
1222  0398 C29D03               JNZ     INVR1           ; JUMP IF MONOCHROM
1223  039B 06FA                 MVI     B,0FAH
1224                    INVR1:
1225  039D 3A5007               LDA     INVFLG          ; GET ATTRIBUTE BYTE
1226  03A0 A0                   ANA     B               ; RESET HALF INTENSITY FLAG
1227  03A1 325007               STA     INVFLG
1228  03A4 C3CE00               JMP     POPREG
1229
1230
1231
1232                    PAGE
```

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                        034    (PBIOS)

1233
1234
1235                    ;*********************************************************************
1236                    ;*                                                                   *
1237                    ;*      REVERSE  SET / RESET OF INVERSE VIDEO                        *
1238                    ;*                                                                   *
1239                    ;*********************************************************************
1240                    ;
1241                    ;
1242                    ;
1243                    ;
1244                    REVERSE:
1245  03A7 3EFF                 MVI     A,0FFH          ; SET DATA REQUEST FLAG
1246  03A9 324C07               STA     DRQ
1247  03AC 21B503               LXI     H,RV0
1248  03AF 224E07               SHLD    DRQADR          ; SAVE DRQ ADDRESS
1249  03B2 C3CE00               JMP     POPREG
1250                    ;
1251                    ; SET/RESET INVERS AND/OR BLINKING
1252                    ;
1253                    RV0:
1254  03B5 79                   MOV     A,C             ; TEST FOR SET / RESET INVERSE VIDEO
1255  03B6 FE30                 CPI     '0'
1256  03B8 C2F903               JNZ     RV1             ; IF RESET INVERSE AND BLINKING
1257  03BB 3A5007               LDA     INVFLG
1258  03BE E6FD                 ANI     0FDH            ; RESET BLINKING
1259  03C0 325007               STA     INVFLG
1260  03C3 3A5407               LDA     COLORI          ; GET COLOR INDEX
1261  03C6 FE43                 CPI     'C'
1262  03C8 C2F103               JNZ     RV2             ; JUMP IF MONOCHROM
1263  03CB 3A5107               LDA     REVVID          ; GET REVERSE VIODEO ON OFF FLAG
1264  03CE B7                   ORA     A
1265  03CF CA2C04               JZ      RVE1            ; RETURN IF REVERSE VIDEO STILL RESET
1266  03D2 AF                   XRA     A
1267  03D3 325107               STA     REVVID          ; SET REVERSE VIDEO OFF
1268                    RV3:
1269  03D6 3A5007               LDA     INVFLG
1270  03D9 47                   MOV     B,A             ; SAVE FOR LATER
1271  03DA 07                   RLC
1272  03DB 07                   RLC
1273  03DC 07                   RLC
1274  03DD 2F                   CMA                     ; COMPLEMENT FOREGROUND COLOR
1275  03DE E6E0                 ANI     0E0H            ; MASK NEW BACKGROUND COLOR
1276  03E0 4F                   MOV     C,A             ; SAVE FOR LATER
1277  03E1 78                   MOV     A,B             ; GET ORIGINAL
1278  03E2 0F                   RRC
1279  03E3 0F                   RRC
1280  03E4 0F                   RRC
1281  03E5 2F                   CMA                     ; COMPLEMENT BACKGROUND COLOR
1282  03E6 E61C                 ANI     01CH            ; MASK NEW FOREGROUND COLOR
1283  03E8 B1                   ORA     C               ; COMBINE WITH  BACKGROUND COLOR
1284  03E9 4F                   MOV     C,A             ; SAVE AGAIN
1285  03EA 78                   MOV     A,B
1286  03EB E603                 ANI     03H             ; MASK BLINK AND HALF DENSITY
1287  03ED B1                   ORA     C
1288  03EE C32904               JMP     RVE
```

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                        035    (P8IOS)

1289                    RV2:
1290    03F1 3A5007             LDA     INVFLG          ;   THEN
1291    03F4 E6FE               ANI     0FEH            ;   RESET INVERSE VIDEO FLAG
1292    03F6 C32904             JMP     RVE
1293                    RV1:                            ;   ELSE
1294    03F9 FE32               CPI     '2'
1295    03FB C20604             JNZ     RV5             ;   IF SET BLINKING
1296    03FE 3A5007             LDA     INVFLG
1297    0401 F602               ORI     02H             ;     SET BLINKING
1298    0403 C32904             JMP     RVE             ;   RETURN
1299                    RV5:
1300    0406 FE34               CPI     '4'             ;   IF SET INVERSE
1301    0408 C22C04             JNZ     RVE1            ;
1302    040B 3A5407             LDA     COLORI          ; GET COLOR INDEX
1303    040E FE43               CPI     'C'
1304    0410 CA1B04             JZ      RV4             ; JUMP IF COLOR
1305    0413 3A5007             LDA     INVFLG          ;     THEN
1306    0416 F601               ORI     1               ;     SET INVERSE VIDEO FLAG
1307    0418 C32904             JMP     RVE             ;   ENDIF
1308                    RV4:
1309    041B 3A5107             LDA     REVVID          ; GET REVERSE VIDEO ON OFF FLAG
1310    041E B7                 ORA     A
1311    041F C22C04             JNZ     RVE1            ; RETURN IF REVERSE VIDEO ALWAYS SET
1312    0422 3C                 INR     A
1313    0423 325107             STA     REVVID          ; SET REVERSE VIDEO ON
1314    0426 C3D603             JMP     RV3
1315                    RVE:                            ;
1316    0429 325007             STA     INVFLG          ; SET/RESET ATTRIBUTE'S
1317                    RVE1:                           ; ENDIF
1318    042C AF                 XRA     A               ; RESET DRQ FLAG
1319    042D 324C07             STA     DRQ
1320    0430 C3CE00             JMP     POPREG          ; RETURN
1321
1322
1323                    PAGE
```

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                        036    (PBIOS)

1324
1325
1326                    ;*****************************************************************
1327                    ;*                                                               *
1328                    ;*      BELL    RING THE BELL                                    *
1329                    ;*                                                               *
1330                    ;*****************************************************************
1331
1332                    BELL:
1333    0433 CD3904             CALL    BELLOUT         ; BELL
1334    0436 C3CE00             JMP     POPREG
1335                    ;
1336                    ;       A - COMMAND/DATA BYTE
1337                    ;
1338                    BELLOUT:
1339    0439 4F                 MOV     C,A             ; SAVE COMMAND/DATA BYTE
1340    043A DB41       BELL2:  IN      RSKEY           ; GET STATUS FROM KBD
1341    043C E601               ANI     OUTPBFF
1342    043E CA4304             JZ      BELL1           ; JUMP IF OUTPUTBUFFER EMPTY
1343    0441 DB40               IN      RDKEY           ; DUMMY READ NEEDED BY THE 8041
1344    0443 DB41       BELL1:  IN      RSKEY
1345    0445 E602               ANI     INPBFF
1346    0447 C23A04             JNZ     BELL2           ; JUMP IF INPUT BUFFER FULL
1347    044A 79                 MOV     A,C             ; RESTORE COMMAND/DATA BYTA
1348    044B D341       F023    OUT     KBELL
1349    044D C9                 RET
1350
1351                            PAGE
```

```
1352
1353                    ;*********************************************************
1354                    ;*                                                       *
1355                    ;*  MUSIC    PLAY MUSIC INTERFACE                        *
1356                    ;*                                                       *
1357                    ;*********************************************************
1358                    ;
1359                    ;
1360                    ;
1361                    ;
1362  044E 3EFF         MUSIC:  MVI     A,0FFH
1363  0450 324C07               STA     DRQ             ; SET DATA REQ. FLAG
1364  0453 216104               LXI     H,GETFRQ
1365  0456 224E07               SHLD    DRQADR          ; SET DATA REQUEST ADDRESS
1366  0459 3E06                 MVI     A,MUSICC
1367  045B CD3904               CALL    BELLOUT         ; SEND COMMAND
1368  045E C3CE00               JMP     POPREG
1369                    ;
1370                    GETFRQ:
1371  0461 79                   MOV     A,C
1372  0462 CD3904               CALL    BELLOUT         ; SEND FREQUENCE
1373  0465 216E04               LXI     H,GETLEN
1374  0468 224E07               SHLD    DRQADR          ; SET DATA REQUEST ADDRESS
1375  046B C3CE00               JMP     POPREG
1376                    ;
1377                    ;
1378                    ;
1379                    GETLEN:
1380  046E 79                   MOV     A,C
1381  046F CD3904               CALL    BELLOUT         ; SEND LENGTH OF FREQ.
1382  0472 AF                   XRA     A
1383  0473 324C07               STA     DRQ             ; RESET DATA REQUEST FLAG
1384  0476 C3CE00               JMP     POPREG
1385
1386
1387
1388                                    PAGE
```

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                    038    (PBIOS)

1389
1390
1391                ;*****************************************************************
1392                ;*                                                               *
1393                ;*      INLINE  INSERT LINE AT CURRENT CURSOR POSITION           *
1394                ;*                                                               *
1395                ;*****************************************************************
1396
1397
1398  0479 3A4707   INLINE: LDA     CURROW          ; GET Y-POSITION
1399  047C CD8106           CALL    SCROLLDN        ; MOVE REST OF SCREEN DOWN
1400  047F C3CE00           JMP     POPREG
1401
1402
1403
1404                ;*****************************************************************
1405                ;*                                                               *
1406                ;*      DELINE  DELETE LINE AT CURRENT CURSOR POSITION           *
1407                ;*                                                               *
1408                ;*****************************************************************
1409
1410
1411                DELINE:
1412  0482 3A4707           LDA     CURROW          ; GET Y-POSITION
1413  0485 CD2A06           CALL    SCROLLUP        ; MOVE REST OF SCREEN UP
1414  0488 C3CE00           JMP     POPREG          ;
1415
1416
1417                        PAGE
```

```
1418
1419                    ;*****************************************************************
1420                    ;*                                                               *
1421                    ;*      INCHAR  INSERT CHARACTER AT CURRENTCURSOR POSITION       *
1422                    ;*                                                               *
1423                    ;*****************************************************************
1424
1425
1426                    INCHAR:
1427  0488 2A4607               LHLD    CURCOL
1428  048E CDFB06               CALL    WRHLPOS
1429  0491 3A4607               LDA     CURCOL
1430  0494 4F                   MOV     C,A
1431  0495 3E4F                 MVI     A,LWID-1        ; A - NUMBER OF CHAR TO MOVE
1432  0497 91                   SUB     C
1433  0498 CAC204               JZ      INCHA2
1434
1435  0498 4F                   MOV     C,A
1436
1437  049C 2A4607               LHLD    CURCOL          ; HL - CURRENT POSITION
1438  049F 2E4E                 MVI     L,LWID-2        ; START ADDRESS FOR MOVE
1439
1440  04A1 CDFB06               CALL    WRHLPOS
1441  04A4 CD0802               CALL    CUROFF          ; CURSOR OFF
1442                    INCHA1:
1443  04A7 E5                   PUSH    H
1444  04A8 CD5C01               CALL    SETCUR          ; SET CURSOR
1445  04AB CDF300               CALL    RDGCHR          ; GET CHARACTER
1446  04AE E1                   POP     H
1447  04AF 23                   INX     H
1448  04B0 E5                   PUSH    H
1449  04B1 CD5C01               CALL    SETCUR          ; SET CURSOR
1450  04B4 CDE500               CALL    WRGCHR          ; SET CHARACTER
1451  04B7 E1                   POP     H
1452  04B8 2B                   DCX     H
1453  04B9 2B                   DCX     H
1454  04BA 0D                   DCR     C
1455  04BB C2A704               JNZ     INCHA1          ; JUMP IF NOT ALL CHAR MOVED
1456  04BE CD1302               CALL    CURON           ; CURSOR ON
1457  04C1 23                   INX     H
1458                    INCHA2:
1459  04C2 E5                   PUSH    H
1460  04C3 0E20                 MVI     C,' '           ; INSERT A SPACE
1461  04C5 CDAB02               CALL    TRNCHR          ; TRANSLATE THE SPACE
1462  04C8 E1                   POP     H
1463  04C9 59                   MOV     E,C             ; CHARACTER --) E
1464  04CA CD5C01               CALL    SETCUR          ; SET CURSOR
1465  04CD 3A5007               LDA     INVFLG          ; GET ATTRIBUTE
1466  04D0 57                   MOV     D,A
1467  04D1 CDE500               CALL    WRGCHR          ; CLEAR CHARACTER
1468  04D4 CDED06               CALL    WRCUPO          ; SET CURSOR
1469  0407 C3CE00               JMP     POPREG
1470
1471
1472
1473                            PAGE
```

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                    040    (PBIOS)

1474
1475                ;*****************************************************************
1476                ;*                                                               *
1477                ;*      DECHAR- DELETE CHARACTER AT CURRENT CURSOR POSITION      *
1478                ;*                                                               *
1479                ;*****************************************************************
1480
1481
1482                DECHAR:
1483    04DA 2A4607         LHLD    CURCOL
1484    04DD CDFB06         CALL    WRHLPOS
1485    04E0 3A4607         LDA     CURCOL
1486    04E3 4F             MOV     C,A
1487    04E4 3E4F           MVI     A,LWID-1
1488    04E6 91             SUB     C               ; A - NUMBER OF CHAR TO MOVE
1489    04E7 CACA05         JZ      DECHA2          ; JUMP IF NO CHAR TO MOVE
1490
1491    04EA 4F             MOV     C,A
1492
1493    04EB 23             INX     H               ; HL - START ADDRESS TO MOVE
1494    04EC CD0802         CALL    CUROFF          ; CURSOR OFF
1495
1496                DECHA1:
1497    04EF E5             PUSH    H
1498    04F0 CD5C01         CALL    SETCUR          ; SET CURSOR
1499    04F3 CDF300         CALL    RDGCHR          ; GET CHARACTER
1500    04F6 E1             POP     H
1501    04F7 2B             DCX     H
1502    04F8 E5             PUSH    H
1503    04F9 CD5C01         CALL    SETCUR          ; SET CURSOR
1504    04FC CDE500         CALL    WRGCHR          ; SET CHARACTER
1505    04FF E1             POP     H
1506    0500 23             INX     H
1507    0501 23             INX     H
1508    0502 0D             DCR     C
1509    0503 C2EF04         JNZ     DECHA1          ; JUMP IF NOT ALL CHAR MOVED
1510    0506 CD1302         CALL    CURON           ; CURSOR ON
1511    0509 2B             DCX     H
1512                DECHA2:
1513    050A E5             PUSH    H
1514    050B 0E20           MVI     C,' '           ; INSERT A SPACE
1515    050D CDAB02         CALL    TRNCHR          ; TRANSLATE THE SPACE
1516    0510 E1             POP     H
1517    0511 59             MOV     E,C             ; CHARACTER --) E
1518    0512 CD5C01         CALL    SETCUR          ; SET CURSOR
1519    0515 3A5007         LDA     INVFLG          ; GET ATTRIBUTE
1520    0518 57             MOV     D,A
1521    0519 CDE500         CALL    WRGCHR          ; CLEAR LAST CHARACTER
1522    051C CDED06         CALL    WRCUPO          ; SET CURSOR
1523    051F C3CE00         JMP     POPREG
1524
1525
1526
1527                PAGE
```

```
1528
1529                    ;*********************************************************************
1530                    ;*                                                                   *
1531                    ;*      EREOL   ERASE FROM CURRENT POSITIONTO END OF LINE            *
1532                    ;*                                                                   *
1533                    ;*********************************************************************
1534
1535
1536  0522 CDE805   EREOL:  CALL    CLREOL          ; CLEAR TO END OF LINE
1537  0525 C3CE00           JMP     POPREG          ;
1538
1539
1540                        rAGE
```

```
                042    (PBIOS)

1541
1542                ;*********************************************************************
1543                ;*                                                                   *
1544                ;*      FSPACE  FORWARD SPACE                                        *
1545                ;*                                                                   *
1546                ;*********************************************************************
1547
1548                FSPACE:
1549    0528 3A4607         LDA     CURCOL          ; GET X-POSITION + 1
1550    052B 3C             INR     A               ;
1551    052C 324607         STA     CURCOL
1552    052F FE50           CPI     LWID            ;
1553    0531 DA3A05         JC      FSPACE1         ; FALL THRU IF LINEFEED REQUIRED
1554    0534 CD2206         CALL    COLUM0          ; SET X-POSITION TO 0
1555    0537 CD4005         CALL    LFEED           ; LINEFEED
1556                FSPACE1:
1557    053A CDED06         CALL    WRCUP0          ; SET CURSOR
1558    053D C3CE00         JMP     POPREG          ;
1559
1560
1561
1562                ;*********************************************************************
1563                ;*                                                                   *
1564                ;*      LFEED   LINE FEED                                            *
1565                ;*                                                                   *
1566                ;*********************************************************************
1567
1568                LFEED:
1569    0540 3A4707         LDA     CURROW          ; Y-POSITION + 1
1570    0543 3C             INR     A               ;
1571    0544 FE18           CPI     LINES
1572    0546 D25005         JNC     LFEED1          ; JUMP IF SCROLL REQUIRED
1573    0549 324707         STA     CURROW
1574    054C CDED06         CALL    WRCUP0          ; UPDATE CURRENT CURSOR POSITION
1575    054F C9             RET
1576                LFEED1:
1577    0550 C35A06         JMP     SCLUP3
1578
1579
1580
1581                ;*********************************************************************
1582                ;*                                                                   *
1583                ;*      LINEFD  LINEFEED                                             *
1584                ;*                                                                   *
1585                ;*********************************************************************
1586
1587
1588                LINEFD:
1589    0553 CD4005         CALL    LFEED           ; LINEFEED
1590    0556 C3CE00         JMP     POPREG
1591
1592
1593                        PAGE
```

```
1594
1595                    ;*****************************************************************
1596                    ;*                                                               *
1597                    ;*      CARRET  CARRIAGE RETURN                                  *
1598                    ;*                                                               *
1599                    ;*****************************************************************
1600
1601                    CARRET:
1602    0559 CD2206             CALL    COLUM0          ; SET X-POSITION = 0
1603    055C C3CE00             JMP     POPREG          ;
1604
1605
1606
1607                    ;*****************************************************************
1608                    ;*                                                               *
1609                    ;*      BACKSP  BACKSPACE                                        *
1610                    ;*                                                               *
1611                    ;*****************************************************************
1612
1613                    BACKSP:
1614    055F 3A4607             LDA     CURCOL
1615    0562 3D                 DCR     A               ; X-POSITION - 1
1616    0563 F27A05             JP      BKSP1           ; JUMP IF X-POSITION >= 0
1617    0566 3A4707             LDA     CURROW          ;
1618    0569 3D                 DCR     A               ; Y-POSITION - 1
1619    056A F27505             JP      BKSP2           ; JUMP IF Y-POSITION >= 0
1620    056D 3E00               MVI     A,0             ;
1621    056F 324707             STA     CURROW          ; SET Y-POSITION = 0
1622    0572 C37A05             JMP     BKSP1
1623                    BKSP2:
1624    0575 324707             STA     CURROW          ; SET Y-POSITION
1625    0578 3E4F               MVI     A,LWID-1        ; X-POSITION = SCREEN WIDTH
1626                    BKSP1:
1627    057A 324607             STA     CURCOL          ; SET NEW X-POSITION
1628    057D CDED06             CALL    WRCUP0          ; SET CURSOR
1629    0580 C3CE00             JMP     POPREG          ;
1630
1631                            PAGE
```

```
                    044    (PBIOS)

1632
1633                ;*********************************************************************
1634                ;*                                                                   *
1635                ;*      RLFEED  REVERSE LINE FEED                                    *
1636                ;*                                                                   *
1637                ;*********************************************************************
1638
1639                RLFEED:
1640    0583 3A4707         LDA     CURROW          ; Y-POSITION - 1
1641    0586 3D             DCR     A               ;
1642    0587 FA8D05         JM      RLFEED1
1643    058A 324707         STA     CURROW          ;
1644                RLFEED1:
1645    058D CDED06         CALL    WRCUPO          ; SET CURSOR
1646    0590 C3CE0C         JMP     POPREG
1647
1648
1649                        PAGE
```

```
1650
1651                    ;*****************************************************************
1652                    ;*                                                               *
1653                    ;*      CURHOM  CURSOR HOME                                      *
1654                    ;*                                                               *
1655                    ;*****************************************************************
1656
1657                    CURHOM:
1658  0593 CD9905               CALL    HOME            ; CURSOR HOME
1659  0596 C3CE00               JMP     POPREG          ;
1660
1661
1662                    ;*****************************************************************
1663                    ;*                                                               *
1664                    ;*      HOME    HOME CURSOR SUBROUTINE                           *
1665                    ;*                                                               *
1666                    ;*****************************************************************
1667
1668                    HOME:
1669  0599 210000               LXI     H,0             ; X-POSITION = 0
1670  059C 224607               SHLD    CURCOL          ; Y-POSITION = 0
1671  059F CDED06               CALL    WRCUPO          ; SET CURSOR
1672  05A2 C9                   RET
1673
1674
1675
1676                    ;*****************************************************************
1677                    ;*                                                               *
1678                    ;*      CLEAR   CLEAR SCREEN, CURSOR HOME                        *
1679                    ;*                                                               *
1680                    ;*****************************************************************
1681
1682
1683                    CLEAR:
1684  05A3 CD0802               CALL    CUROFF
1685  05A6 CDE901               CALL    INIT10          ; INITIALIZE PAGES
1686  05A9 CD4F02               CALL    SCROL1
1687  05AC 210000               LXI     H,0             ; START OF CRT RAM
1688  05AF 010007               LXI     B,LINES*LWID+LWID ; LENGTH TO CLEAR
1689  05B2 CD0E06               CALL    CLEARSP
1690  05B5 CD9905               CALL    HOME            ; CURSOR HOME
1691  05B8 CD1302               CALL    CUROW
1692  05BB C3CE00               JMP     POPREG          ;
1693
1694
1695
1696
1697
1698                            PAGE
```

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                    046    (PBIOS)

1699
1700                ;*****************************************************************
1701                ;*                                                               *
1702                ;*      CLREOS  CLEAR FROM CURRENT POSITION TO END OF SCREEN     *
1703                ;*                                                               *
1704                ;*****************************************************************
1705
1706
1707                CLREOS:
1708  05BE 3A4707           LDA     CURROW
1709  05C1 4F               MOV     C,A
1710  05C2 3E17             MVI     A,LINES-1       ; A = NUMBER OF LINES TO CLEAR
1711  05C4 91               SUB     C
1712  05C5 CAE205           JZ      CLREOS1         ; JUMP IF ONLY ONE LINE TO CLEAR
1713
1714  05C8 2E00             MVI     L,0
1715  05CA 61               MOV     H,C
1716  05CB 24               INR     H
1717  05CC CDFB06           CALL    WRHLPOS         ; HL - START OF CLEAR AREA
1718  05CF E5               PUSH    H
1719  05D0 215000           LXI     H,LWID
1720  05D3 CD0000           CALL    MULT            ;
1721  05D6 4D               MOV     C,L
1722  05D7 44               MOV     B,H             ; BC - NUMBER OF BYTES TO CLEAR
1723  05D8 E1               POP     H
1724  05D9 CD0802           CALL    CUROFF
1725  05DC CD0E06           CALL    CLEARSP         ; CLEAR BC BYTES STARTING WITH HL
1726  05DF CD1302           CALL    CURON
1727                CLREOS1:
1728  05E2 CDE805           CALL    CLREOL          ; CLEAR TO END OF LINE
1729  05E5 C3CE00           JMP     POPREG
1730
1731                        PAGE
```

```
1732
1733                    ;*****************************************************************
1734                    ;*                                                               *
1735                    ;*      CLREOL  CLEAR FROM CURRENT POSITION TO END OF LINE       *
1736                    ;*                                                               *
1737                    ;*****************************************************************
1738
1739                    CLREOL:
1740    05E8 3A4607             LDA     CURCOL
1741    05EB 47                 MOV     B,A
1742    05EC 6F                 MOV     L,A
1743    05ED 3E50               MVI     A,LWID
1744    05EF 90                 SUB     B               ; A - NUMBER OF BYTES TO CLEAR
1745    05F0 C8                 RZ                      ; NOTHING TO CLEAR
1746    05F1 0600               MVI     B,0             ;
1747    05F3 4F                 MOV     C,A             ;
1748    05F4 C5                 PUSH    B
1749    05F5 3A4707             LDA     CURROW
1750    05F8 67                 MOV     H,A
1751    05F9 CDFB06             CALL    WRHLPOS         ; HL - A(CHARACTER IN CRT-RAM)
1752    05FC C1                 POP     B               ; BC - # OF BYTES TO CLEAR
1753    05FD CD0E06             CALL    CLEARSP         ; CLEAR REQUESTED NUMBER OF BYTES
1754    0600 C9                 RET
1755
1756
1757
1758                    ;*****************************************************************
1759                    ;*                                                               *
1760                    ;*      CLRLIN  CLEAR LINE                                       *
1761                    ;*              A - LINE NUMBER                                  *
1762                    ;*                                                               *
1763                    ;*****************************************************************
1764
1765                    CLRLI1:
1766    0601 67                 MOV     H,A             ;
1767    0602 2E00               MVI     L,0             ; X-POSITION = 0
1768    0604 CDFB06             CALL    WRHLPOS         ; HL - A (LINE IN CRT RAM)
1769    0607 015000             LXI     B,LWID          ; SCREEN WIDTH
1770    060A CD0E06             CALL    CLEARSP         ; CLEAR THE LINE
1771    060D C9                 RET
1772
1773                    PAGE
```

```
                    048    (PBIOS)

1774
1775
1776                ;*****************************************************************
1777                ;*                                                               *
1778                ;*      CLEARSP    CLEAR BC - BYTES IN CRT-RAM                   *
1779                ;*                 HL - START ADDRESS IN CRT RAM                 *
1780                ;*                                                               *
1781                ;*****************************************************************
1782
1783
1784                CLEARSP:
1785  060E E5               PUSH    H
1786  060F C5               PUSH    B               ;
1787  0610 0E20             MVI     C,' '           ;
1788  0612 CDAB02           CALL    TRNCHR          ; TRANSLATE SPACE
1789  0615 59               MOV     E,C             ;
1790  0616 C1               POP     B               ;
1791  0617 E1               POP     H
1792  0618 CD5C01           CALL    SETCUR          ; SET CURSOR
1793  061B CD1401           CALL    SPCLEAR1        ; GDC CLEAR ROUTINE
1794  061E CDED06           CALL    WRCUPO
1795  0621 C9               RET
1796                        PAGE


                    049    (PBIOS)

1797
1798                ;*****************************************************************
1799                ;*                                                               *
1800                ;*      COLUMO  SET X-POSITION = 0                               *
1801                ;*                                                               *
1802                ;*****************************************************************
1803
1804                COLUMO:
1805  0622 AF               XRA     A               ;
1806  0623 324607           STA     CURCOL          ; SET X-POSITION = 0
1807  0626 CDED06           CALL    WRCUPO          ; SET CURSOR
1808  0629 C9               RET
1809
1810
1811
1812
1813                        PAGE
```

```
1814
1815                    ;*****************************************************************
1816                    ;*                                                               *
1817                    ;*      SCROLLUP        MOVES SCREEN ONE LINE UP                 *
1818                    ;*                      A - SECIFIED LINE                        *
1819                    ;*                                                               *
1820                    ;*****************************************************************
1821
1822
1823                    SCROLLUP:
1824  062A B7                   ORA     A
1825  062B CA5A06               JZ      SCLUP3          ; SCROLL ALL
1826  062E 47                   MOV     B,A             ;
1827  062F 3E17                 MVI     A,LINES-1       ;
1828  0631 90                   SUB     B               ; A - NUMBER OF LINES TO MOVE
1829  0632 CA4406               JZ      SCLUP2          ; JUMP IF NO LINE TO MOVE
1830  0635 4F                   MOV     C,A             ;
1831  0636 CD0802               CALL    CUROFF          ; CURSOR OFF
1832                    SCLUP1:
1833  0639 CDCA06               CALL    MUROW           ; MOVE ONE LINE UP
1834  063C 04                   INR     B
1835  063D 0D                   DCR     C
1836  063E C23906               JNZ     SCLUP1          ; NEXT LINE
1837  0641 CD1302               CALL    CURON           ; CURSOR ON
1838                    ;
1839                    SCLUP2:
1840  0644 3E17                 MVI     A,LINES-1       ; CLEAR LINE 25
1841  0646 CD0000               CALL    CLRLIN
1842  0649 AF                   XRA     A
1843  064A 324607               STA     CURCOL          ; X - POS = 0
1844  064D CDED06               CALL    WRCUPO          ; SET CURSOR
1845  0650 C9                   RET
1846
1847                    SCLUP4:
1848  0651 AF                   XRA     A
1849  0652 324607               STA     CURCOL
1850  0655 3E17                 MVI     A,23            ; CURRENT ROW = 24
1851  0657 324707               STA     CURROW
1852                    SCLUP3:
1853  065A CD0802               CALL    CUROFF
1854  065D 218007               LXI     H,24*80
1855  0660 E5                   PUSH    H
1856  0661 CD5C01               CALL    SETCUR          ; READ AND SAVE LINE 25
1857  0664 CD9501               CALL    RDLIN
1858  0667 E1                   POP     H
1859  0668 015000               LXI     B,80
1860  066B CD0E06               CALL    CLEARSP         ; CLEAR ERROR LINE
1861  066E CD2802               CALL    SCROLL          ; SCROLL WHOLE SCREEN
1862  0671 218007               LXI     H,24*80
1863  0674 CD5C01               CALL    SETCUR          ; RESTORE LINE 25
1864  0677 CDC001               CALL    WRLIN           ; AND DISPLAY IT AGAIN
1865  067A CD1302               CALL    CURON
1866  067D CDED06               CALL    WRCUPO          ; SET CURSOR
1867  0680 C9                   RET
1868
1869                            PAGE
```

```
                        051    (PBIOS)

1870
1871                    ;*****************************************************************
1872                    ;*                                                               *
1873                    ;*      SCROLLDN        MOVES SCREEN ONE LINE DOWN               *
1874                    ;*                      A - SPECIFIED LINE                       *
1875                    ;*                                                               *
1876                    ;*****************************************************************
1877
1878
1879                    SCROLLDN:
1880    0681 F5                 PUSH    PSW             ;
1881    0682 47                 MOV     B,A             ;
1882    0683 3E17               MVI     A,LINES-1       ;
1883    0685 90                 SUB     B               ; A - NUMBER OF LINES TO MOVE
1884    0686 CA9A06             JZ      SCLDN2          ; JUMP IF NO LINE TO MOVE
1885    0689 4F                 MOV     C,A             ;
1886    068A 0616               MVI     B,LINES-2       ; START WITH LINE BEFORE LAST
1887    068C CD0802             CALL    CUROFF          ; CURSOR OFF
1888                    SCLDN1:
1889    068F CDA606             CALL    MDROW           ; MOVE ONE LINE DOWN
1890    0692 05                 DCR     B
1891    0693 0D                 DCR     C
1892    0694 C28F06             JNZ     SCLDN1          ; NEXT LINE
1893    0697 CD1302             CALL    CURON           ; CURSOR ON
1894                    ;
1895                    SCLDN2:
1896    069A F1                 POP     PSW             ; RESTORE LINE NUMBER
1897    069B CD0000             CALL    CLRLIN          ; CLEAR THIS LINE
1898    069E AF                 XRA     A
1899    069F 324607             STA     CURCOL          ; X - POS = 0
1900    06A2 CDED06             CALL    WRCUPO          ; SET CURSOR
1901    06A5 C9                 RET
1902
1903                    PAGE
```

```
1904
1905                    ;*****************************************************************
1906                    ;*                                                               *
1907                    ;*      MDROW   MOVE LINE B TO LINE B+1                          *
1908                    ;*                                                               *
1909                    ;*****************************************************************
1910
1911                    MDROW:
1912  06A6 C5                   PUSH    B               ;
1913  06A7 D5                   PUSH    D               ;
1914  06A8 E5                   PUSH    H               ; LINE
1915  06A9 78                   MOV     A,B             ; NUMBER TO A
1916  06AA 2600                 MVI     H,0
1917  06AC 2E50                 MVI     L,LWID
1918  06AE CD0000               CALL    MULT            ; HL - LINE B * 80
1919  06B1 EB                   XCHG
1920  06B2 215000               LXI     H,LWID
1921  06B5 19                   DAD     D               ; HL = LINE B+1   DE = LINE B
1922  06B6 0E50                 MVI     C,LWID          ; C - # OF CHARACTERS / LINES
1923                    MDROW1:
1924  06B8 EB                   XCHG
1925  06B9 CD5C01               CALL    SETCUR          ; SET CURSOR
1926  06BC EB                   XCHG
1927  06BD CD9501               CALL    RDLIN           ; GET CHARACTER AND ATTRIBUTE
1928  06C0 CD5C01               CALL    SETCUR          ; SET CURSOR TO DESTINATION
1929  06C3 CDC001               CALL    WRLIN           ; WRITE CHARACTER AND ATTRIBUTE
1930  06C6 E1                   POP     H               ;
1931  06C7 D1                   POP     D               ;
1932  06C8 C1                   POP     B               ; RESTORE REGS
1933  06C9 C9                   RET
1934
1935
1936
1937                    PAGE
```

```
                        053    (PBIOS)

1938
1939                    ;*****************************************************************
1940                    ;*                                                               *
1941                    ;*      MUROW   MOVE LINE IN B+1 TO LINE B                       *
1942                    ;*                                                               *
1943                    ;*****************************************************************
1944
1945                    MUROW:
1946    06CA C5                 PUSH    B               ;
1947    06CB D5                 PUSH    D               ;
1948    06CC E5                 PUSH    H               ;
1949    06CD 78                 MOV     A,B             ; LINE NUMBER TO A
1950    06CE 2600               MVI     H,0
1951    06D0 2E50               MVI     L,LWID
1952    06D2 CD0090             CALL    MULT
1953    06D5 EB                 XCHG
1954    06D6 215000             LXI     H,LWID
1955    06D9 19                 DAD     D               ; HL = LINE B+1   DE = LINE B
1956    06DA 0E50               MVI     C,LWID          ; C - # OF CHARACTERS / LINE
1957                    MUROW1:
1958    06DC CD5C01             CALL    SETCUR          ; SET CURSOR
1959    06DF E8                 XCHG
1960    06E0 CD9501             CALL    RDLIN           ; GET CHARACTER AND ATTRIBUTE
1961    06E3 CD5C01             CALL    SETCUR          ; SET CURSOR TO DESTINATION
1962    06E6 CDC001             CALL    WRLIN           ; WRITE CHARACTER
1963    06E9 E1                 POP     H               ;
1964    06EA D1                 POP     D               ;
1965    06EB C1                 POP     B               ; RESTORE REGS
1966    06EC C9                 RET
1967
1968                            PAGE
```

```
1969
1970                    ;*****************************************************************
1971                    ;*                                                               *
1972                    ;*      WRCUP0  WRITE CURRENT CURSOR POSITION                    *
1973                    ;*                                                               *
1974                    ;*****************************************************************
1975
1976
1977                    WRCUP0:
1978    06ED F5                 PUSH    PSW
1979    06EE E5                 PUSH    H
1980    06EF 2A4607             LHLD    CURCOL          ;L = CURRENT COLUMN
1981                                                    ;H = CURRENT ROW
1982    06F2 CDFB06             CALL    WRHLPOS         ;CALCULATE CURSOR POSITION
1983    06F5 CD5C01             CALL    SETCUR          ;SET CURSOR
1984    06F8 E1                 POP     H
1985    06F9 F1                 POP     PSW
1986    06FA C9                 RET
1987
1988
1989
1990                    ;*****************************************************************
1991                    ;*                                                               *
1992                    ;*      WRHLPOS         COMPUTE ADDRESS WITHIN CRT-BUFFER        *
1993                    ;*                      H - LINE                                 *
1994                    ;*                      L - COLUMN                               *
1995                    ;*                                                               *
1996                    ;*****************************************************************
1997
1998
1999                    WRHLPOS:
2000    06FB F5                 PUSH    PSW
2001    06FC E5                 PUSH    H
2002    06FD 7C                 MOV     A,H
2003    06FE 2600               MVI     H,0
2004    0700 2E50               MVI     L,LWID
2005    0702 CD0000             CALL    MULT            ; HL - RELATIVE ADDRESS OF ROW
2006    0705 EB                 XCHG
2007    0706 E1                 POP     H
2008    0707 2600               MVI     H,0             ; L - COLUMN
2009    0709 19                 DAD     D               ; HL - ROW * 80  + COLUMN
2010    070A F1                 POP     PSW
2011    070B C9                 RET
2012
2013
2014
2015
2016
2017                            PAGE
```

```
                    055    (PBIOS)

2018
2019                       GDCIOM
2020      +        ;               GDC I/O MACRO  27/10/82 10:00 WF
2021      +        ;               ================================
2022      +        OUTCMD:
2023   070C+CD1807 1       CALL    FIFRDY          ;PUT A COMMAND TO GDC
2024   070F+D3A1   1       OUT     GDCCOM
2025   0711+C9     1       RET
2026      +        ;
2027      +        OUTPAR:
2028   0712+CD1807 1       CALL    FIFRDY          ;PUT A PARAMETER TO GDC
2029   0715+D3A0   1       OUT     GDCPAR
2030   0717+C9     1       RET
2031      +        ;
2032      +        FIFRDY:
2033   0718+F5     1       PUSH    PSW             ;CHECK AND WAIT FOR FIFO READY
2034      +        FIFO10:
2035   0719+DBA0   1       IN      GDCSTA          ;READ GDC STATUS
2036   071B+E602   1       ANI     FIFULL
2037   071D+C21907 1       JNZ     FIFO10          ;WAIT IF FIFO FULL
2038   0720+F1     1       POP     PSW
2039   0721+C9     1       RET
2040      +        ;
2041      +        CKDATR:
2042   0722+F5     1       PUSH    PSW             ;CHACK AND WAIT FOR DATA READY
2043      +        CKDA10:
2044   0723+DBA0   1       IN      GDCSTA          ;READ GDC STATUS
2045   0725+E601   1       ANI     DATRDY          ;
2046   0727+CA2307 1       JZ      CKDA10          ;WAIT IF FIFO FULL
2047   072A+F1     1       POP     PSW
2048   072B+C9     1       RET
2049      +        ;
2050      +        INPAR:
2051   072C+CD2207 1       CALL    CKDATR          ;READ FROM FIFO
2052   072F+DBA1   1       IN      FIFO
2053   0731+C9     1       RET
2054      +        ;
2055      +        SENPAR:
2056   0732+7E     1       MOV     A,M             ;LOAD PARAMETER
2057   0733+CD1207 1       CALL    OUTPAR          ;PUT PARAMETER TO GDC
2058   0736+23     1       INX     H               ;POINTER TO NEXT PARAMETER
2059   0737+05     1       DCR     B               ;PARAMETER COUNTER - 1
2060   0738+C23207 1       JNZ     SENPAR          ;JUMP IF NOT AT END
2061   073B+C9     1       RET
2062      +        ;
2063      +        CHKDIP:
2064   073C+F5     1       PUSH    PSW             ;CHECK FOR DRAWING IN PROCESS
2065      +        CKDP10:
2066   073D+DBA0   1       IN      GDCSTA          ;READ GDC STATUS
2067   073F+E608   1       ANI     DRWINP          ;
2068   0741+C23007 1       JNZ     CKDP10          ;JUMP IF DRAWING IN PROCESS
2069   0744+F1     1       POP     PSW
2070   0745+C9     1       RET
2071      +                PAGE
```

```
2072      +
2073      +         ;
2074      +                 ENDM
2075
2076                ;*****************************************************************
2077                ;*                                                               *
2078                ;*              VIDEO DATA AREA                                  *
2079                ;*                                                               *
2080                ;*****************************************************************
2081
2082
2083  0746 00       CURCOL: DB      0               ; CURRENT COLUMN NUMBER
2084  0747 00       CURROW: DB      0               ; CURRENT ROW NUMBER
2085
2086  0748 =        TMPXY   EQU     $               ; TEMPORARY ROW/COL STORAGE
2087  0748 00       TMPCOL: DB      0               ; TEMPORARY STORAGE FOR COLUMN
2088  0749 00       TMPROW: DB      0               ; TEMPORARY STORAGE FOR ROW
2089
2090
2091  074A 0000     CURPOS: DW      0               ; CURSOR POSITION IN RAM
2092  074C 00       DRQ:    DB      0               ; DATA REQUEST FLAG
2093  074D 00       ESCFLG: DB      0               ; ESCAPE FLAG
2094  074E 0000     DRQADR: DW      0               ; DATA REQUEST ADDRESS POINTER
2095  0750 E8       INVFLG: DB      0E8H            ; ATTRIBUTE BYTE
2096                                                ; BACKGROUND - BLACK
2097  0751 00       REVVID: DB      0               ; REVERSE VIDEO ON OFF FLAG 1=ON 0 = OFF
2098  0752 00       SCROW:  DB      0               ; SCROLLING ROW NUMBER
2099
2100  0753 00       YPOS:   DB      0               ; CURSOR CONTROL DATA
2101
2102  0754 00       COLORI: DB      0               ; COLOR INDEX BYTE 'C'-COLOR
2103
2104  0755                  END
```

057 (PBIOS)

ALV0	FA80	181↕	182
ALV1	FAE0	183↕	184
ALV2	FB71	185↕	187
ALV3	FBC2	187↕	189
ALV4	FC13	189↕	191
ALV5	FC64	191↕	193
ALV6	FCB5	193↕	195
ALV7	FD06	195↕	197
ALV8	FD57	197↕	199
ALV9	FDA8	199↕	201
BACKSP	055F	1076	1613↕
BELL	0433	1074	1332↕
BELL1	0443	1342	1344↕
BELL2	043A	1340↕	1346
BELLOUT	0439	1333	1338↕ 1367 1372 1381
BKSP1	057A	1616	1622 1626↕
BKSP2	0575	1619	1623↕
BS	0008	162↕	
CARRET	0559	1084	1601↕
CCHAR	0048	518↕	838 846
CHAMOD	0020	567↕	
CHKDIP	073C	2063↕	
CINIT	0000	103	267↕
CKDA10	0723	2043↕	2046
CKDATR	0722	2041↕	2051
CKDP10	0730	2065↕	2068
CLEAR	05A3	1088	1109 1111 1683↕
CLEARSP	060E	860	1689 1725 1753 1770 1784↕ 1860
CLREOL	05E8	1536	1728 1739↕
CLREOS	05BE	1117	1119 1707↕
CLREOS1	05E2	1712	1727↕
CLRLI1	0601	102	104 1765↕
CLRLIN	0000	83	1841 1897
CLRSCN	001A	166↕	
COAD	0026	233↕	
COLORI	0754	277	1200 1220 1260 1302 2102↕
COLUMO	0622	1554	1602 1804↕
COMPDEHL	0000	80	690 735
COMTBL	02EA	940	1072↕
CONIN	003A	103	321↕
CONOUT	0048	104	338↕
CONST	002C	103	304↕
COTC	0027	234↕	
COUNTRY	0001	127↕	
CPMRAM	0000	138↕	
CPMVER	0002	139↕	
CR	000D	160↕	
CRTOUT	00A7	342	343 366 368 410 592↕
CRTTBL	0000	80	1002
CSV0	FAA0	182↕	183
CSV1	FB31	184↕	185
CSV2	0000	186↕	
CSV3	0000	188↕	
CSV4	0000	190↕	
CSV5	0000	192↕	
CSV6	0000	194↕	

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                    058    (PBIOS)

CSV7                0000   196#
CSV8                0000   198#
CSV9                0000   200#
CURCOL              0746   102   634   902   906   914   920  1178  1427  1429  1437
                           1483  1485  1549  1551  1614  1627  1670  1740  1806  1843
                           1849  1899  1980  2083#
CURD                00E0   527#
CURDISK             0004   159#
CURHOM              0593  1092  1657#
CUROFF              0208   837# 1441  1494  1684  1724  1831  1853  1887
CURON               0213   845# 1456  1510  1691  1726  1837  1865  1893
CURPOS              074A   938  1048  2091#
CURROW              0747   911   921   923  1183  1398  1412  1569  1573  1617  1621
                           1624  1640  1643  1708  1749  1851  2084#
CURS                0049   521#  742
DATRDY              0001   503#  2045
DCOMD               0051   221#
DECHA1              04EF  1496#  1509
DECHA2              050A  1489   1512#
DECHAR              04DA  1131   1482#
DELINE              0482  1127   1411#
DESLCT              0000    84    271
DIRBUF              FA00   180#   181
DISFD               0007   244#
DMACOM              0028   235#
DMAEXC              0010   507#
DMAMB               002A   238#
DMAMO               0028   237#
DMAR                00A4   550#
DMAREAD             0008   241#
DMAST               0028   236#
DMAWR               0004   240#
DNBRR               0001   144#
DNBRS               0000   145#
DPB0                FE99   202#  203
DPB1                FEA8   203#  204
DPB2                FEB7   204#  205
DPB3                FEC6   205#  206
DPB4                FED5   206#  207
DPB5                FEE4   207#  208
DPB6                FEF3   208#  209
DPB7                FF02   209#  210
DPB8                FF11   210#  211
DPB9                FF20   211#
DRQ                 074C   102   598  1156  1181  1246  1319  1363  1383  2092#
DRQADR              074E   102   601  1158  1170  1248  1365  1374  2094#
DRWALL              0000   576#
DRWINP              0008   506# 2067
DRWRET              0010   577#
DSTAT               0050   222#
DYNRAM              0004   574#
EMFD                0003   243#
EREOL               0522  1086  1121  1123  1536#
ESC                 001B   165#
ESCAPE              0203   597  1045#
```

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                        OSY    (PBIOS)

ESCFLG          0740   595  1046  1058  2093#
ESCTBL          0308  1050  1108#
FDCRA           0051   223#
FF              000C   163#
FIFEMP          0004   505#
FIFO            00A1   484# 2052
FIFO10          0719  2034# 2037
FIFRDY          0718  2023  2028  2032#
FIFULL          0002   504# 2036
FIGD            006C   525#
FIGS            004C   524#  669   706   769   796   827
FINDAD          0295   959#  968  1051
FINDCH          028E   608   937#
FSPACE          0528  1082  1548#
FSPACE1         053A  1553  1556#
FUNCCH          0000    80  1137
FWVER           0FF7   146#  276
GCHRD           0068   526#
GDCCOM          00A1   489# 2024
GDCPAR          00A0   488# 2029
GDCRES          0000   515#
GDCSTA          00A0   483# 2035  2044  2066
GETFRQ          0461  1364  1370#
GETLEN          046E  1373  1379#
GETLPOS         0000    83  1003
GETX            0360  1169  1174#
GETX1           0368  1177  1179#
GETY            034C  1157  1162#
GETY1           0357  1166  1168#
GRAEND          1FFF   496#
GRAMOD          0002   566#
HALFRES         0391  1115  1218#
HALFSET         037B  1113  1198#
HOME            0599  1658  1668# 1690
HORETR          0040   509#
HSTBUF          F600   179#  180
INCHA1          04A7  1442# 1455
INCHA2          04C2  1433  1458#
INCHAR          0488  1129  1426#
INIT10          01E9   817#  867  1685
INLINE          0479  1125  1398#
INLRPF          0008   570#
INPAR           072C   679   681   782  2050#
INPBFF          0002   123# 1345
INTLAC          0009   571#
INVFLG          0750   640   718  1205  1207  1225  1227  1257  1259  1269  1290
                       1296  1305  1316  1465  1519  2095#
INVR1           0390  1222  1224#
INVS1           0387  1202  1204#
IOBSET          0000    81   268
IOBYTE          0003   158#  269   282   305   322   339   359   380   405   425
KBDAT           0001   126#
KBDINIT         0000    83   270
KBELL           0041   120# 1348
KCOUNT          0041   121#
KEYBASE         0040   115#  117   118   119   120   121
```

061 (PBIOS)

```
PUSCUR          033E  1133  1154#
PRAM            0070   530#  874
PRAMSA          0000   531#
PRTOUT          0000    82   367   411
PRTSTAT         0000    82   431
PUNCH           0056   103   359#
PUTCHR          00C4   609#
RAMSEL          0010   228#  278
RDAT            00A0   546#  677   777
RDGCHR          00F3   668#  1445  1499
RDKEY           0040   118#  1343
RDLIN           0195   766#  1857  1927  1960
RDLIN1          01B4   781#  786
READER          0068   103   379#
RELEASE         0004   141#
RELEASEH        0000   140#
RESMOP          0000   562#
REVERSE         03A7  1139  1244#
REVVID          0751  1263  1267  1309  1313  2097#
RLFEED          0583  1080  1639#
RLFEED1         0580  1642  1644#
ROMSEL          0011   229#  275
ROUT1           00A2   451   453#
ROUTE           0098   102   285   306   323   340   364   383   408   428   445#
RSKEY           0041   119#  1340  1344
RV0             03B5  1247  1253#
RV1             03F9  1256  1293#
RV2             03F1  1262  1289#
RV3             0306  1268#  1314
RV4             041B  1304  1308#
RV5             0406  1295  1299#
RVE             0429  1288  1292  1298  1307  1315#
RVE1            042C  1265  1301  1311  1317#
SACTIVE         0000    83   281
SATRM           0000   573#
SCLDN1          068F  1888#  1892
SCLDN2          069A  1884  1895#
SCLUP1          0639  1832#  1836
SCLUP2          0644  1829  1839#
SCLUP3          065A  1577  1825  1852#
SCLUP4          0651   637  1847#
SCROL1          024F   868   873#  1686
SCROLL          0228   857#  1861
SCROLLDN        0681  1399  1879#
SCROLLUP        062A  1413  1823#
SCROW           0752  2098#
SENPAR          0732   878  2055#  2060
SETCUR          015C   728#  1444  1449  1464  1498  1503  1518  1792  1856  1863
                       1925  1928  1958  1961  1983
SETCUR1         0170   702   740#
SETCUR2         016F   736   738#
SETESC          02E2  1057#  1090
SETMSK          0187   705   750   757#
SETTC           0012   230#
SIOINIT         0000    80   286   287   289
SP1             0250   731   820   861   864   877   882#
```

```
                    062    (PBIOS)

SP2             0261   821   885*
SPCLEAR1        0114   686*  1793
SPCLEAR2        0136   692   693   698   703*
SRLCOUT         0000    81   341   344   365
SRLIN           0000    81   324   327   384   387
SRLINST         0000    81   307   310
SRLOUT          0000    82   409   412
SRLSTAT         0000    82   429   432
START           0068   519*
SUBHLDE         0000    82   696   737
SYSSTA          0013   231*
TMPCOL          0748   102  2087*
TMPROW          0749  2088*
TMPXY           0748  2086*
TOF             000C   164*
TRANS           0000    84   994
TRNCHR          02A8   102   610   993*  1461  1515  1788
TRNCHR1         028C  1009*  1017
TRNCHR2         02C8   996  1021*
TRNSPC          02B2   102   997*
TYHIBY          0018   539*
TYLOBY          0010   538*
TYWORD          0000   537*  655   677   714   803
VERETR          0020   508*
VID1            008C   600   605*
VSYNCM          006F   517*
VSYNCS          006E   516*
WDAT            0020   534*  655   714   803
WDKEY           0040   117*
WINIT           0016   103   279*
WPL             0024   498*
WRCUP0          06ED   104   924  1184  1468  1522  1557  1574  1628  1645  1671
                      1794  1807  1844  1866  1900  1977*
WRGCHR          00E5   642   654*  1450  1467  1504  1521
WRHLPOS         06FB  1428  1440  1484  1717  1751  1768  1982  1999*
WRLIN           01C0   793*  1864  1929  1962
WRLIN1          01D0   807*  812
YPOS            0753  1167  1182  2100*
ZOOM            0046   520*
```

```
                        003    (QBIOS)

68
69                      ;*************************************************************
70                      ;*************************************************************
71                      ;********                                             ********
72                      ;********       EXTERNAL DEFINITIONS                  ********
73                      ;********                                             ********
74                      ;*************************************************************
75                      ;*************************************************************
76                      ;
77                      ;
78                      ;
79                      EXTRN   POPREG,MODCRT,TRNSPC,DRQ,DRQADR,CURCOL,TMPCOL
80                      EXTRN   CONFIGFL,KEYTBL,FUNTBL,FNTBLND,FNERRM
81                      EXTRN   DISPERR,CONIN,CLRLIN,OFST
82                      EXTRN   MOVE,ROUTE,SUBHLDE,COMPDEHL,MOVEL
83                      EXTRN   M1RS232,M2RS232,PVRS232
84
85
86                              PAGE



                        004    (QBIOS)

87
88
89
90                      ;*************************************************************
91                      ;*************************************************************
92                      ;********                                             ********
93                      ;********       ENTRY DEFINITIONS                     ********
94                      ;********                                             ********
95                      ;*************************************************************
96                      ;*************************************************************
97                      ;
98                      ;
99                      ;
100
101                     PUBLIC  LANGUAGE,KEYIN,KEYST,GETLPOS,FUNCCH,KBDINIT,TRANS
102
103                     PUBLIC  PRTSTAT,PRTOUT,PIOINIT
104
105                     PUBLIC  SRLIN,SRLINST,SRLOUT,SRLSTAT,SRLCOUT,SACTIVE,SIOINIT
106
107
108                             PAGE
```

```
109
110                ;*****************************************************************
111                ;*****************************************************************
112                ;********                                               ********
113                ;********              KDB ROUTINES                     ********
114                ;********                                               ********
115                ;*****************************************************************
116                ;*****************************************************************
117
118                KEYEQU
119       +        ;*****************************************************************
120       +        ;*                                                               *
121       +        ;*                KEYBOARD EQUATES 27/10/82 10:27 WF             *
122       +        ;*                                                               *
123       +        ;*****************************************************************
124    0040+=      KEYBASE EQU     0040H           ; BASE ADDRESS OF KEYBOARD
125       +
126    0040+=      WDKEY   EQU     KEYBASE         ; WRITE DATA TO KEYBOARD
127    0040+=      RDKEY   EQU     KEYBASE         ; READ DATA FROM KEYBOARD
128    0041+=      RSKEY   EQU     KEYBASE+1       ; READ KEYBOARD STATUS
129    0041+=      KBELL   EQU     KEYBASE+1       ; RING BELL
130    0041+=      KCOUNT  EQU     KEYBASE+1       ; COUNTRY CODE PORT
131       +
132    0002+=      INPBFF  EQU     02H             ; INPUTBUFFER FULL
133    0001+=      OUTPBFF EQU     01H             ; OUTPUTBUFFER FULL
134    0080+=      LGDAT   EQU     80H             ; LANGUAGE CODE READY FLAG
135    0001+=      KBDAT   EQU     01H             ; DATA READY BIT
136    0001+=      COUNTRY EQU     01H             ; COMMAND TO GET COUNTRY CODE
137    0006+=      MUSICC  EQU     06H             ; MUSIC COMMAND
138       +        ;
139       +                EMDM
140
141
142
143
144    0000 00     LANGUAGE:       DB      0       ; LANGUAGE CODE
145                                                ; 0 - US/HEBREW
146                                                ; 1 - UK
147                                                ; 2 - FRANCE
148                                                ; 3 - GERMANY
149                                                ; 4 - SWEDEN
150                                                ; 5 - DANSK
151                                                ; 6 - SPAIN
152                                                ; 7 - ITALY
153                                                ; 8 - SWISS
154                                                ; 9 - CANADA 1
155                                                ;10 - CANADA 2
156                                                ;11 - SOUTH AFRICA
157                                                ;12 - PORTUGAL
158                                                ;13 - YUGUSLAVIA
159
160
161    0001 00     TRANS:  DB      0               ;SOFTWARE SWITCH
162                        PAGE
```

```
                        006    (QBIOS)

                ;*****************************************************************
                ;*                                                               *
                ;*      KBDINIT GET COUNTRY CODE                                 *
                ;*                                                               *
                ;*****************************************************************


                KBDINIT:
0002 3E01               MVI     A,COUNTRY
0004 D341               OUT     KCOUNT
                KBDIN1:
0006 DB41               IN      RSKEY
0008 E601               ANI     KBDAT
000A CA0600             JZ      KBDIN1          ; WAIT UNTIL A CHARACTER IS READY
000D DB41               IN      RSKEY
000F E680               ANI     LGDAT
0011 C21900             JNZ     KBDIN2          ; LANGUAGE CODE READY
0014 DB40               IN      RDKEY           ; CLEAR OUTPUTBUFFER
0016 C30600             JMP     KBDIN1          ; GET LANGUGE CODE
                KBDIN2:
0019 DB40               IN      RDKEY           ; GET LANGUAGE CODE
001B 47                 MOV     B,A             ; SAVE LANGUAGE CODE
001C 2F                 CMA
001D E6F0               ANI     0F0H            ; MASK HIGH BYTE TO GET KBD VERSION
001F 0F                 RRC
0020 4F                 MOV     C,A
0021 78                 MOV     A,B             ; GET ORIGINAL VALUE
0022 E607               ANI     07H             ; MASK OUT LANGUAGE VERSION
0024 81                 ADD     C               ; COMBINE IT WITH KBD VERSION
0025 213000             LXI     H,LTAB
0028 CD0000             CALL    OFST
002B 7E                 MOV     A,M             ; GET LANGUAGE CODE OUT OF TABLE
002C 320000             STA     LANGUAGE        ; SET LANGUAGE CODE
002F C9                 RET


                        PAGE


                        007    (QBIOS)

                ;
                ;
                ;       LTAB TRANSLATES KBD/LANGUAGE VERSION TO PHYSICAL
                ;       TRANSLATION TABLE ENTRY
                ;
                ;
0030 0001020304LTAB:    DB      00H,01H,02H,03H,04H,05H,06H,07H ; KBD VERSION 1 OLD
0038 0001050304         DB      00H,01H,05H,03H,04H,05H,06H,07H ; KBD VERSION 1 NEW
0040 0808020904         DB      08H,08H,02H,09H,0AH,0BH,0CH,0DH ; KBD VERSION 2
0048 0000000000         DB      00H,00H,00H,00H,00H,00H,00H,00H ; KBD VERSION 3
                        PAGE
```

```
                        008    (QBIOS)

218
219                     ;*****************************************************************
220                     ;*                                                               *
221                     ;*      KEYST   KEYBOARD SYSTEM STATUS                           *
222                     ;*              RETURN REGISTER A = OFFH IF CHARACTER READY      *
223                     ;*                                  A = 0 IF CHARACTER NOT READY *
224                     ;*                                                               *
225                     ;*****************************************************************
226
227
228                     KEYST:
229   0050 3AE201               LDA     FACTIVE
230   0053 B7                   ORA     A
231   0054 C0                   RNZ                     ; RETURN IF FUNCTION KEY ACTIVE
232   0055 CDA500               CALL    PKEYST          ; GET KBD STATUS
233   0058 C9                   RET
234
235
236
237                             PAGE



                        009    (QBIOS)

238
239                     ;*****************************************************************
240                     ;*                                                               *
241                     ;*      KEYIN   KEYIN WITH EXPANDING FUNCTIONS                   *
242                     ;*                                                               *
243                     ;*****************************************************************
244
245
246   0059 3AE201   KEYIN:  LDA     FACTIVE
247   005C B7               ORA     A
248   005D C27A00           JNZ     KEYSY1          ; JUMP IF FUNCTION KEY ACTIVE
249                 KEYSY2:
250   0060 CDAE00           CALL    PKEYIN          ; GET KEY BUFFER --> A
251   0063 FE80             CPI     80H
252   0065 D8               RC                      ; RETURN ASCII CHARACTER
253   0066 FEA0             CPI     0A0H
254   0068 DA8200           JC      KBDTRN          ; JUMP IF CHARACTER BETWEEN 80H AND 9FH
255   006B 4F               MOV     C,A             ; SAVE CHARACTER --> C
256   006C 3A0000           LDA     CONFIGFL
257   006F B7               ORA     A
258   0070 C28000           JNZ     KEYSY4          ; JUMP IF FLAG SET (RET. FUCT CHAR)
259   0073 79               MOV     A,C             ; RESTORE CHARACTER
260   0074 CDB700   KEYSY3: CALL    FUNSET          ; SET UP FUNCTION KEY HANDLING
261   0077 CA6000           JZ      KEYSY2          ; JUMP IF AN INACTIVE FUNCTION
262   007A CDE400   KEYSY1: CALL    FUNGETN         ; GET NEXT CHAR
263   007D CCF400           CZ      FUNCLOS         ; DEACTIVATE FUNCTION KEY HANDLING
264   0080 79       KEYSY4: MOV     A,C             ; CHARACTER --> A
265   0081 C9               RET
266                         PAGE
```

```
                    010    (QBIOS)

267
268                 ;*****************************************************************
269                 ;*                                                               *
270                 ;*      KBDTRN  TRANSLATE KEY TO ASCII CHARACTER                 *
271                 ;*                                                               *
272                 ;*****************************************************************
273
274
275                 KBDTRN:
276   0082 FE9E             CPI     09EH
277   0084 DA9300           JC      KBDTR1          ;JUMP IF = ( THEN 9EH
278   0087 3EFF             MVI     A,0FFH
279   0089 CA8D00           JZ      KBDTR2          ;JUMP IF SOFTWARE SWITCH ON
280   008C AF               XRA     A               ;SOFTWARE SWITCH OFF
281                 KBDTR2:
282   008D 320100           STA     TRANS           ;SET SOFTWARE SWITCH
283   0090 C36000           JMP     KEYSY2          ;GET NEXT CHARACTER
284
285                 KBDTR1:
286   0093 4F               MOV     C,A
287   0094 CD0000           CALL    TRNSPC          ; TRANSLATE CHARACTER
288   0097 79               MOV     A,C
289   0098 FE80             CPI     80H
290   009A D8               RC                      ; RETURN IF TRANSLATED
291   009B E61F             ANI     01FH            ; CLEAR BIT 5,6,7
292   009D 210000           LXI     H,KEYTBL        ; POINT TO START OF TRANSLATE TABLE
293   00A0 CD0000           CALL    OFST            ; HL = HL + A
294   00A3 7E               MOV     A,M
295   00A4 C9               RET
296
297                         PAGE
```

```
298
299                     ;*****************************************************************
300                     ;*                                                               *
301                     ;*      PKEYST  GET KBD STATUS                                   *
302                     ;*              Z SET IF DATA READY                              *
303                     ;*                                                               *
304                     ;*****************************************************************
305
306                     PKEYST:
307   00A5 DB41                 IN      RSKEY           ; GET STATUS
308   00A7 E601                 ANI     KBDAT           ;
309   00A9 C8                   RZ                      ; NO DATA READY
310   00AA 3EFF                 MVI     A,0FFH          ;
311   00AC B7                   ORA     A               ; DATA READY
312   00AD C9                   RET
313
314
315                     ;*****************************************************************
316                     ;*                                                               *
317                     ;*      PKEYIN  GET KEYBOARD CHARACTER                           *
318                     ;*              A - CHARACTER                                    *
319                     ;*                                                               *
320                     ;*****************************************************************
321
322
323                     PKEYIN:
324   00AE CDA500               CALL    PKEYST          ; TEST KEYBOARD STATUS
325   00B1 CAAE00               JZ      PKEYIN          ; WAIT UNTIL A CHARACTER READY
326   00B4 DB40                 IN      RDKEY           ; GET KBD-CHARACTER
327   00B6 C9                   RET
328
329                     PAGE
```

```
012    (QBIOS)

330
331             ;*********************************************************************
332             ;*********************************************************************
333             ;********                                                     ********
334             ;********       FUNCTION KEY HANDLING                         ********
335             ;********                                                     ********
336             ;*********************************************************************
337             ;*********************************************************************
338             ;*********************************************************************
339             ;*                                                                   *
340             ;*     FUNSET  SETUP FUNCTION KEY RUE STRINGS  RETURN WITH           *
341             ;*             FCHARCNT, THE CHAR COUNT. AND FPOINTER                *
342             ;*             THE POINTER INTO FUNCTION STRING.                     *
343             ;*             FUNCTION ARE DEFINED AS:                              *
344             ;*             A0 - B3                                               *
345             ;*             C0 - D3                                               *
346             ;*             E0 - F3                                               *
347             ;*                                                                   *
348             ;*                                                                   *
349             ;*********************************************************************
350
351
352             FUNSET:
353  0087 E61F          ANI     01FH            ; MASK FUNCTION NUMBER
354  0089 FE14  F34F    CPI     20
355  008B D2D400        JNC     FUNSET1         ; JUMP IF FUNCTION CODE ) 20
356  008E CDD600        CALL    GETFPOS         ; GET POSITION OF FUNCTION
357  00C1 7E            MOV     A,M             ; CHAR COUNT IN [A]
358  00C2 3D            DCR     A               ; CORRECT FUNCTION LENGTH
359  00C3 CAD400        JZ      FUNSET1         ; JUMP IF FUNCTION LENGTH = 0
360  00C6 23            INX     H               ; POINT TO 1ST CHARACTER
361  00C7 22E401        SHLD    FPOINTER        ; SAVE AS POINTER TO BEGING OF STRING
362  00CA 32E301        STA     FCHARCNT        ; SAVE [A] AS CHAR COUNT
363  00CD 3EFF          MVI     A,0FFH
364  00CF 32E201        STA     FACTIVE         ; INDICATOR THAT FUN IS ACT
365  00D2 B7            ORA     A               ; INDICATE ACTIVE FUNCTION
366  00D3 C9            RET
367
368             FUNSET1:
369  00D4 AF            XRA     A               ; RETURN INVALID FUNCTION
370  00D5 C9            RET
371                     PAGE
```

```
                        ;*****************************************************************
                        ;*                                                               *
                        ;*  GETFPOS     SET POSITION OF REQUESTED FUNCTION               *
                        ;*              A - FUNCTION #                                   *
                        ;*                                                               *
                        ;*              HL - ADDRESS OF FUNCTION                         *
                        ;*****************************************************************
                        ;
                        ;
                        GETFPOS:
0006 210000                     LXI     H,FUNTBL        ; START OF FUNCTION TABLE

                        ;*****************************************************************
                        ;*                                                               *
                        ;*  GETLPOS     GET POSITION OF REQUESTED TABLE ENTRY            *
                        ;*              Entry:          A  - TABLE ENTRY NUMBER          *
                        ;*                              HL - TABLE START ADDRESS         *
                        ;*                                                               *
                        ;*              Exit:           HL - ADDRESS IN TABLE            *
                        ;*****************************************************************
                        ;
                        GETLPOS:
0009 47                         MOV     B,A             ;
000A 04                         INR     B
000B 05                 GETF1:  DCR     B               ; DECREMENT TABLE ENTRY COUNTER
000C C8                         RZ                      ; RETURN IF FUNCTION REACHED
000D 7E                         MOV     A,M             ; GET FUNCTION LENGTH
000E CD0000                     CALL    OFST            ; ADD FUNCTION LEGTH TO ADDRESS
00E1 C30B00                     JMP     GETF1
                                PAGE
```

```
                        014    (QBIOS)

403
404                     ;*********************************************************************
405                     ;*                                                                   *
406                     ;*      FUNGETN GET NEXT CHAR FROM THE FUNCTION TABLE                *
407                     ;*              RETURNS CHAR IN [C] , COUNT REMAINING IN [A]         *
408                     ;*                                                                   *
409                     ;*********************************************************************
410
411
412                     FUNGETN:
413   00E4 2AE401               LHLD    FPOINTER        ; FPOINTER POINTS TO NEXT CHAR
414   00E7 4E                   MOV     C,M             ; GET CHAR TO [C]
415   00E8 23                   INX     H               ; BUMP POINTER
416   00E9 22E401               SHLD    FPOINTER        ; SAVE BUMPED POINTER
417   00EC 3AE301               LDA     FCHARCNT        ; GET CHAR COUNT
418   00EF 3D                   DCR     A               ; DEC TO ZERO
419   00F0 32E301               STA     FCHARCNT        ; SAVE OLD CHAR
420   00F3 C9                   RET                     ; RETURN WITH COUNT FLAGS SET
421
422
423                     ;*********************************************************************
424                     ;*                                                                   *
425                     ;*      FUNCLOS DEACTIVATE FUNCTION KEY HANDLING                     *
426                     ;*                                                                   *
427                     ;*********************************************************************
428
429
430                     FUNCLOS:
431   00F4 AF                   XRA     A
432   00F5 32E201               STA     FACTIVE         ; RESET FUNCTION KEY ACTIVE FLAG
433   00F8 C9                   RET
434                             PAGE


                        015    (QBIOS)

435
436                     ;*********************************************************************
437                     ;*                                                                   *
438                     ;*  FUNCCH    CHANGE FUNCTION VALUE                                  *
439                     ;*                                                                   *
440                     ;*********************************************************************
441                     ;
442                     ;
443                     FUNCCH:
444   00F9 3EFF                 MVI     A,0FFH
445   00FB 320000               STA     DRQ             ; SET DATA REQUEST BYTE
446   00FE 32EE01               STA     FNERR           ; SET NO ERROR OCCURED BYTE
447   0101 210A01               LXI     H,GETFCHR
448   0104 220000               SHLD    DRQADR          ; SET ADDRESS OF 'GET FUNC. CHR' ROUTINE
449   0107 C30000               JMP     POPREG
450
451
452
453                             PAGE
```

```
                ;*********************************************************************
                ;*                                                                   *
                ;*  GETFCHR     GET FUN. CHR. WHICH SHOULD CHANGED                   *
                ;*                                                                   *
                ;*********************************************************************


                GETFCHR:
010A 79                 MOV     A,C
010B 32E601             STA     FNCCHAR         ; SAVE FUNCTION #
010E E61F               ANI     1FH
0110 CD0600             CALL    GETFPOS
0113 7E                 MOV     A,M             ; GET FUNCTION LENGTH
0114 23                 INX     H
0115 22E701             SHLD    FNSTR           ; SET START ADDRESS OF NEW FUNC.
0118 22E901             SHLD    FNACT           ; SET ACTUAL FNC-ADDRESS
011B CD0000             CALL    OFST            ; COMPUTE ADDRESS OF NEXT FUNCTION
011E 2B                 DCX     H
011F CD0701             CALL    GFNLN           ; COMPUTE RESTSIZE OF FOLLOWING FUNC.
0122 22E801             SHLD    RSTLEN          ; SAVE RESTLENGTH
0125 44                 MOV     B,H
0126 4D                 MOV     C,L
0127 2AE701             LHLD    FNSTR           ; GET FUNCTION START ADDRESS
012A EB                 XCHG
012B CD0000             CALL    MOVE            ; MOVE REST OF FUNC. TO START OF NEW
012E EB                 XCHG
012F 2B                 DCX     H               ; LAST FUNCTION CHARACTER
0130 22EF01             SHLD    FNEND           ; SAVE LAST CHARACTER ADDRESS
0133 3E01               MVI     A,1
0135 32ED01             STA     FNLEN           ; SET LENGTH OF FUNC = 0
0138 214101             LXI     H,CHCHR
013B 220000             SHLD    DRQADR          ; SET ADDRESS OF 'GET NEW FUNC. CHR.'
013E C30000             JMP     POPREG
                        PAGE
```

```
                    017    (QBIOS)

489
490                 ;*****************************************************************
491                 ;*                                                               *
492                 ;*  CHCHR       CHANGE ONE CHARACTER UND UPDATE POINTERS         *
493                 ;*                                                               *
494                 ;*****************************************************************
495
496
497                 CHCHR:
498   0141 3AE601           LDA     FNCCHAR
499   0144 B9               CMP     C
500   0145 CA7E01           JZ      CHCHEND         ; JUMP IF END OF FUNC. CHANGE
501   0148 3AEE01           LDA     FNERR
502   014B B7               ORA     A
503   014C CA0000           JZ      POPREG          ; DOESN'T ACCEPT CHARACTER (ERROR)
504   014F C5               PUSH    B               ; SAVE NEW CHARACTER
505   0150 21ED01           LXI     H,FNLEN
506   0153 34               INR     M               ; FUNCTION LENGTH + 1
507   0154 21EB01           LXI     H,RSTLEN
508   0157 4E               MOV     C,M
509   0158 23               INX     H
510   0159 46               MOV     B,M             ; BC = RESTLENGTH
511   015A 2AEF01           LHLD    FNEND
512   015D 23               INX     H
513   015E 22EF01           SHLD    FNEND           ; SET NEW END ADDRESS
514   0161 EB               XCHG
515   0162 210000           LXI     H,FNTBLND       ; TABLE END
516   0165 CD0000           CALL    COMPDEHL
517   0168 CA8801           JZ      FUNERR          ; JUMP IF END OF TABLE REACHED
518   016B 2AEF01           LHLD    FNEND           ; ACTUAL POSITION
519   016E 2B               DCX     H               ; START OF MOVE
520   016F CD0000           CALL    MOVEL           ; MOVE REST OF FUNC ONE CHAR
521   0172 C1               POP     B
522   0173 2AE901           LHLD    FNACT
523   0176 71               MOV     M,C             ; SET NEW CHARACTER INTO FUNC. TABLE
524   0177 23               INX     H
525   0178 22E901           SHLD    FNACT           ; SET NEW ACTUAL FN ADDRESS
526   017B C30000           JMP     POPREG
527                         PAGE
```

```
                        ;*****************************************************************
                        ;*                                                               *
                        ;*   CHCHEND    LAST FUNCTION CHAR ENTERED CLOSE FUNC. CHANGE   *
                        ;*                                                               *
                        ;*****************************************************************


                        CHCHEND:
017E 3AEE01                     LDA     FNERR
0181 B7                         ORA     A
0182 CA9401                     JZ      FNERRD          ; DISPLAY ERROR MESSAGE
0185 3AED01                     LDA     FNLEN
0188 2AE701                     LHLD    FNSTR           ;
0188 2B                         DCX     H
018C 77                         MOV     M,A             ; SET FUNCTION LENGTH
018D AF                         XRA     A
018E 320000                     STA     DRQ             ; RESET REQUEST DATA BYTE
0191 C30000                     JMP     POPREG
                                PAGE
```



```
                        ;*****************************************************************
                        ;*                                                               *
                        ;*  FNERRD      DISPLAY ERROR MESSAGE IF FUNCTION TABLE END       *
                        ;*              REACHED                                          *
                        ;*                                                               *
                        ;*****************************************************************


                        FNERRD:
0194 AF                         XRA     A
0195 320000                     STA     DRQ             ; RESET DATA REQUEST BYTE
0198 2A0000                     LHLD    CURCOL
0198 220000                     SHLD    TMPCOL          ; SAVE ORIGINAL CURSOR
019E 210018             FNERR1: LXI     H,01800H
01A1 220000                     SHLD    CURCOL
01A4 210000                     LXI     H,FNERRM
01A7 CD0000                     CALL    DISPERR         ; DISPLAY ERROR MESSAGE
01AA CD0000                     CALL    CONIN           ; INPUT A CHARACTER
01AD 2A0000                     LHLD    TMPCOL
01B0 220000                     SHLD    CURCOL
0183 3E18                       MVI     A,24
0185 CD0000                     CALL    CLRLIN          ; CLEAR ERROR LINE
0188 C30000                     JMP     POPREG


                                PAGE
```

```
                020    (QBIOS)

577
578             ;*****************************************************************
579             ;*                                                               *
580             ;*  FUNERR      FUNCTION TO LONG (END OF FNTABLE REACHED         *
581             ;*                                                               *
582             ;*****************************************************************
583
584
585
586
587             FUNERR:
588   01BB C1           POP     B               ; CLEAR STACK
589   01BC AF           XRA     A
590   01BD 32EE01       STA     FNERR           ; SET ERROR FLAG
591   01C0 21EB01       LXI     H,RSTLEN
592   01C3 4E           MOV     C,M
593   01C4 23           INX     H
594   01C5 46           MOV     B,M             ; BC = RESTLENGTH
595   01C6 2AE701       LHLD    FNSTR
596   01C9 2B           DCX     H
597   01CA 3601         MVI     M,1             ; SET FUNCTION LENGTH = 0
598   01CC 23           INX     H
599   01CD EB           XCHG
600   01CE 2AE901       LHLD    FNACT           ; HL = NXT FNCT  , DE = STRT OF NEW FNCT
601   01D1 CD0000       CALL    MOVE            ; REMOVE REST OF FUNCTIONS
602   01D4 C30000       JMP     POPREG
603
604
605
606             ;*****************************************************************
607             ;*                                                               *
608             ;*  GFNLN       COMPUTE REST OF FUNCTION LENGTH                  *
609             ;*                                                               *
610             ;*****************************************************************
611
612
613
614             GFNLN:
615   01D7 E5           PUSH    H
616   01D8 3E14         MVI     A,20
617   01DA CDD600       CALL    GETFPOS         ; COMPUTE FUNCTION TABLE END ADDRESS
618   01DD 23           INX     H
619   01DE D1           POP     D
620   01DF C30000       JMP     SUBHLDE
621
622
623
624             PAGE
```

```
625
626                ;*****************************************************************
627                ;*                                                               *
628                ;*      FUNCTION-KEY DATA AREA                                   *
629                ;*                                                               *
630                ;*****************************************************************
631
632
633  01E2 00       FACTIVE:        DB      0       ; FUNCTION EXPANSION ACTIVE FLAG
634  01E3 00       FCHARCNT:       DB      0       ; FUNCTION CHAR COUNT
635  01E4 0000     FPOINTER:       DW      0       ; POINTER INTO CHARSTRING
636  01E6 00       FNCCHAR:        DB      0       ; FUNCTION CHARACTER
637  01E7 0000     FNSTR:          DW      0       ; START OF OLD FUNCTION
638  01E9 0000     FNACT:          DW      0       ; ACTUAL ADDRESS
639  01EB 0000     RSTLEN:         DW      0       ; RESTLENGTH OF FOLLOWING FUNCTIONS
640  01ED 00       FNLEN:          DB      0       ; LENGTH OF NEW FUNCTION
641  01EE 00       FNERR:          DB      0       ; ERROR FLAG
642  01EF 0000     FNEND:          DW      0       ; ACTUAL END ADDRESS WITHIN TABLE
643
644
645
646                        PAGE
```

```
                    022    (QBIOS)

647
648                 ;*****************************************************************
649                 ;*****************************************************************
650                 ;********                                             ********
651                 ;********       SERIAL INTERFACE (RS232)              ********
652                 ;********                                             ********
653                 ;*****************************************************************
654                 ;*****************************************************************
655
656
657                 R232PAEQ
658       +         ;
659       +         ;       PORT ADDRESSES FOR RS232 (2651)  28.10.82  PH
660       +         ;
661   0060+=        SPRDATA EQU     60H             ; READ DATA
662   0061+=        SPRSTAT EQU     61H             ; READ STATUS
663   0063+=        SPRCOM  EQU     63H             ; READ COMMAND
664   0064+=        SPWDATA EQU     64H             ; WRITE DATA
665   0066+=        SPWMODE EQU     66H             ; WRITE MODE
666   0067+=        SPWCOM EQU      67H             ; WRITE COMMAND
667       +         ;
668       +                 ENDM
669                 R232STEQ
670       +         ;
671       +         ;       STATUS EQUATES FOR RS232 (2651)  28.10.82 PH
672       +         ;
673   0001+=        TXRDY   EQU     00000001B       ; TRANSMIT HOLDING REGISTER EMPTY
674   0002+=        RXRDY   EQU     00000010B       ; RECEIVE HOLDING REGISTER EMPTY
675   0004+=        TXEMT   EQU     00000100B       ; CHANGE IN DSR OR DCD OR TRANSMIT
676   0008+=        PARITY  EQU     00001000B       ; PARITY ERROR
677   0010+=        OVERRUN EQU     00010000B       ; OVERRUN ERROR
678   0020+=        FRAMING EQU     00100000B       ; FRAMING ERROR
679   0040+=        DCD     EQU     01000000B       ; DATA CARRIER DETECT
680   0080+=        DSR     EQU     10000000B       ; DATA SET READY
681       +         ;
682       +                 ENDM
683
684
685   0011 =        XON     EQU     11H             ; XON VALUE
686   0013 =        XOFF    EQU     13H             ; XOFF VALUE
687                         PAGE
```

```
                        ;*****************************************************************
                        ;*                                                               *
                        ;*      SIOINIT INITIALIZE THE SERIAL I/O                        *
                        ;*                                                               *
                        ;*****************************************************************


                        SIOINIT:
01F1 3A0000                     LDA     M1RS232 E010
01F4 0366                       OUT     SPWMODE         ; OUT MODE 1 BYTE     = 66H
01F6 3A0000                     LDA     M2RS232 E011
01F9 0366                       OUT     SPWMODE         ; OUT MODE 2 BYTE
01FB 3E37                       MVI     A,37H
01FD D367                       OUT     SPWCOM          ; ENABLE TRANSMITTER AND RECEIVER
                                                        ; SET DTR AND RTS , RESET ERROR

01FF 21FF00                     LXI     H,00FFH
0202 22A402                     SHLD    SACTIVE 75CE    ; ENABLE SERIAL INTERFACE
                                                        ; DISABLE PARALLEL INTERFACE
0205 C9                         RET
                        PAGE
```



```
                        ;*****************************************************************
                        ;*                                                               *
                        ;*      SERIAL  PROTOCOL HANDLER FOR FUTURE EXPANSION            *
                        ;*                                                               *
                        ;*****************************************************************


                        SRLOUT:
0206 3A0000                     LDA     PVRS232         ; GET PROTOCOL VECTOR,
0209 CD0000                     CALL    ROUTE           ;   AND DISPATCH APPROPRIATELY
020C 7102                       DW      SRLCOUT
020E 7102                       DW      SRLCOUT
0210 7102                       DW      SRLCOUT
0212 7102                       DW      SRLCOUT         ; DUMMY FOR INTERRUPT SERVICE ON


                        SRLSTAT:
0214 3A0000                     LDA     PVRS232         ; GET PROTOCOL VECTOR,
0217 CD0000                     CALL    ROUTE           ;   AND DISPATCH
021A 4202                       DW      SRLPRST
021C 4202                       DW      SRLPRST
021E 4202                       DW      SRLPRST
0220 4202                       DW      SRLPRST         ; DUMMY FOR INTERRUPT SERVICE ON

                        PAGE
```

```
                        D25    (QBIOS)

740
741                     ;*****************************************************************
742                     ;*                                                               *
743                     ;*              XON/XOFF SERIAL PROTOCOL                         *
744                     ;*                                                               *
745                     ;*****************************************************************
746
747
748
749                     ;*****************************************************************
750                     ;*                                                               *
751                     ;*      SRLINST GET PRINTER INPUT STATUS                         *
752                     ;*              Z - SET IF NO CHARACTER RECEIVED                 *
753                     ;*              0FFH - IF A CHARACTER RECEIVED                   *
754                     ;*                                                               *
755                     ;*****************************************************************
756
757
758
759                     SRLINST:
760   0222 3AA402               LDA     SACTIVE
761   0225 B7                   ORA     A
762   0226 CCF101               CZ      SIOINIT         ; INIT SERIAL INTERFACE IF REQUIRED
763   0229 DB61                 IN      SPRSTAT
764   022B E638                 ANI     OVERRUN OR PARITY OR FRAMING
765   022D C43902               CNZ     TRERR           ; CALL IF ERROR IN RECEIVER
766   0230 DB61                 IN      SPRSTAT         ; GET INPUT STATUS
767   0232 E602                 ANI     RXRDY
768   0234 C8                   RZ                      ; RETURN IF NO CHARACTER RECEIVED
769   0235 3EFF                 MVI     A,0FFH
770   0237 B7                   ORA     A               ; RETURN CHAR. RECEIVED STATUS
771   0238 C9                   RET
772
773                     TRERR:
774   0239 DB60                 IN      SPRDATA         ; DUMMY READ
775   023B DB63                 IN      SPRCOM          ; READ COMMAND BYTE
776   023D F610                 ORI     10H             ; RESET ERROR
777   023F D367                 OUT     SPWCOM          ; RESET ERROR
778   0241 C9                   RET
779
780
781                             PAGE
```

```
782
783
784                     ;*****************************************************************
785                     ;*                                                               *
786                     ;*      SRLPRST         GET PRINTER STATUS                       *
787                     ;*                      ZERO SET PRINTER NOT READY               *
788                     ;*                                                               *
789                     ;*****************************************************************
790
791                     SRLPRST:
792   0242 3AA402               LDA     SACTIVE
793   0245 B7                   ORA     A
794   0246 CCF101               CZ      SIOINIT ; INIT SERIAL INTERFACE IF REQUIRED
795   0249 CD2202               CALL    SRLINST ; CHECK INPUT STATUS
796   024C CA5502               JZ      SP1     ; JUMP IF NO INPUT
797   024F CD6802               CALL    SRLIN   ; GET INPUT CHARACTER
798   0252 32A602               STA     XOFFFLG ; SAVE FLAG
799   0255 3AA602       SP1:    LDA     XOFFFLG
800   0258 FE13                 CPI     XOFF
801   025A CA6602               JZ      SP2     ; JUMP IF XOFF FLAG SET PRINTER NOT READY
802   025D DB61                 IN      SPRSTAT
803   025F E601                 ANI     TXRDY
804   0261 C8                   RZ              ; RETURN IF TRANSMITTER NOT READY
805   0262 3EFF                 MVI     A,0FFH
806   0264 B7                   ORA     A       ; TRANSMITTER READY
807   0265 C9                   RET
808
809                     SP2:
810   0266 AF                   XRA     A       ; PRINTER NOT READY
811   0267 C9                   RET
812                     PAGE
```

```
                        027    (QBIOS)

813
814
815
816                     ;*********************************************************************
817                     ;*                                                                   *
818                     ;*      SRLIN   GET CHARACTER FROM INTERFACE                         *
819                     ;*                                                                   *
820                     ;*********************************************************************
821
822
823                     SRLIN:
824   0268 CD2202               CALL    SRLINST         ; CHECK INPUT STATUS
825   026B CA6802               JZ      SRLIN           ; WAIT ON INPUT CHARACTER
826   026E DB60                 IN      SPRDATA         ; GET CHARACTER
827   0270 C9                   RET
828
829
830
831                     ;*********************************************************************
832                     ;*                                                                   *
833                     ;*      SRLCOUT         OUTPUT CHARACTER                             *
834                     ;*                      [C] - OUTPUT CHARACTER                       *
835                     ;*                                                                   *
836                     ;*********************************************************************
837
838
839
840
841                     SRLCOUT:
F58C  842   0271 CD4202           CALL    SRLPRST F58C'   ; CHECK OUTPUT STATUS
843   0274 CA7102               JZ      SRLCOUT         ; WAIT UNTIL READY TO TRANSMIT
844   0277 79                   MOV     A,C             ; GET CHARACTER
845   0278 D364                 OUT     SPWDATA
846   027A C9                   RET
847
848                             PAGE
```

```
                        028    (QBIOS)

849
850
851                     ;***************************************************************
852                     ;***************************************************************
853                     ;********                                              ********
854                     ;********      PARALLEL INTERFACE (CENTRONICS)         ********
855                     ;********                                              ********
856                     ;***************************************************************
857                     ;***************************************************************
858
859
860   0060 =            PBDA    EQU     60H             ; DATA PORT
861   0061 =            PBSTA   EQU     61H             ; STATUS PORT
862   0063 =            PBCOM   EQU     63H             ; CONTROL PORT
863
864
865
866   0020 =            BUSY    EQU     20H             ; PRINTER BUSY
867   0002 =            POBF    EQU     02H             ; OUTPUT BUFFER FULL
868
869                             PAGE



                        029    (QBIOS)

870
871
872                     ;***************************************************************
873                     ;*                                                             *
874                     ;*      PIOINIT INIT PARALLEL INTERFACE                        *
875                     ;*                                                             *
876                     ;***************************************************************
877
878
879                     PIOINIT:
880   0278 3EAA                 MVI     A,0AAH
881   027D 0363                 OUT     PBCOM           ; INIT INTERFACE
882
883   027F 2100FF               LXI     H,0FF00H
884   0282 22A402               SHLD    SACTIVE         ; ENABLE PARALLEL INTERFACE
885                                                       ; DISABLE SERIAL INTERFACE
886   0285 C9                   RET
887
888                             PAGE
```

```
                        030    (QBIOS)

 889
 890                    ;*****************************************************************
 891                    ;*                                                               *
 892                    ;*      PRTOUT  OUTPUT CHARACTER                                 *
 893                    ;*                      [C] - OUTPUT CHARACTER                   *
 894                    ;*                                                               *
 895                    ;*****************************************************************
 896
 897
 898                    PRTOUT:
F5D0  899  0286 CD9002          CALL    PRTSTAT         ; CHECK INTERFACE STATUS
      900  0289 CA8602          JZ      PRTOUT          ; JUMP IF PRINTER NOT READY
      901  028C 79              MOV     A,C             ; OUTPUT CHARACTER -) A
F5D7  902  028D D360            OUT     PBDA            ; OUT CHARACTER
      903  028F C9              RET
      904                    F5DF
      905
      906
      907                    ;*****************************************************************
      908                    ;*                                                               *
      909                    ;*      PRTSTAT         GET PRINTER STATUS                       *
      910                    ;*                      ZERO SET PRINTER NOT READY               *
      911                    ;*                                                               *
      912                    ;*****************************************************************
      913
      914
      915                    PRTSTAT:
F5DA  916  0290 3AA502          LDA     PACTIVE
      917  0293 B7              ORA     A
      918  0294 CC7B02          CZ      PIOINIT         ; INIT PARALLEL INTERFACE IF REQUIRED
F5E1  919  0297 DB61            IN      PBSTA
      920  0299 E622            ANI     BUSY OR POBF
      921  029B CAA002    F5E2  JZ      P1STATX         ; JUMP IF PRINTER READY TO RECEIVE A BYTE
      922  029E AF              XRA     A               ; PRINTER NOT READY
      923  029F C9              RET
      924
      925
      926                    P1STATX:
F5EA  927  02A0 3EFF            MVI     A,0FFH
      928  02A2 B7              ORA     A               ; PRINTER READY
F5ED  929  02A3 C9              RET
      930
      931                    PAGE

                        031    (QBIOS)

      932
      933
      934                    ;*****************************************************************
      935                    ;*                                                               *
      936                    ;*      PRINTER DATA AREA                                        *
      937                    ;*                                                               *
      938                    ;*****************************************************************
      939
      940
      941
F5EE  942  02A4 00    SACTIVE:DB    0               ; SERIAL INTERFACE ACTIVE FLAG
      943  02A5 00    PACTIVE:DB    0               ; PARALLEL INTERFACE ACTIVE FLAG
      944
      945
      946  02A6 00    XOFFFLG:DB    0               ; XOFF FLAG
      947  02A7                END
```

033 (QBIOS)

KEYSY2	0060	249#	261	283					
KEYSY3	0074	260#							
KEYSY4	0080	258	264#						
KEYTBL	0000	80	292						
LANGUAGE	0000	101	144#	200					
LGDAT	0080	134#	183						
LTAB	0030	197	213#						
M1RS232	0000	83	697						
M2RS232	0000	83	699						
MODCRT	0000	79							
MOVE	0000	82	479	601					
MOVEL	0000	82	520						
MUSICC	0006	137#							
OFST	0000	81	198	293	400	471			
OUTPBFF	0001	133#							
OVERRUN	0010	677#	764						
P1STATX	02A0	921	926#						
PACTIVE	02A5	916	943#						
PARITY	0008	676#	764						
PBCOM	0063	862#	881						
PBDA	0060	860#	902						
PBSTA	0061	861#	919						
PIOINIT	027B	103	879#	918					
PKEYIN	00AE	250	323#	325					
PKEYST	00A5	232	306#	324					
POBF	0002	867#	920						
PUFREG	0000	79	449	487	503	526	546	572	602
PRTOUT	0286	103	898#	900					
PRTSTAT	0290	103	899	915#					
PVRS232	0000	83	723	732					
RDKEY	0040	127#	185	188	326				
ROUTE	0000	82	724	733					
RSKEY	0041	128#	179	182	307				
RSTLEN	01EB	474	507	591	639#				
RXRDY	0002	674#	767						
SACTIVE	02A4	105	706	760	792	884	942#		
SIOINIT	01F1	105	696#	762	794				
SP1	0255	796	799#						
SP2	0266	801	809#						
SPRCOM	0063	663#	775						
SPRDATA	0060	661#	774	826					
SPRSTAT	0061	662#	763	766	802				
SPWCOM	0067	666#	702	777					
SPWDATA	0064	664#	845						
SPWMODE	0066	665#	698	700					
SRLCOUT	0271	105	725	726	727	728	841#	843	
SRLIN	0268	105	797	823#	825				
SRLINST	0222	105	759#	795	824				
SRLOUT	0206	105	722#						
SRLPRST	0242	734	735	736	737	791#	842		
SRLSTAT	0214	105	731#						
SUBHLDE	0000	82	620						
TMPCOL	0000	79	562	568					
TRANS	0001	101	161#	282					

034 (QBIOS)

TRERR	0239	765	773↕	
TRNSPC	0000	79	287	
TXEMT	0004	675↕		
TXRDY	0001	673↕	803	
WOKEY	0040	126↕		
XOFF	0013	686↕	800	
XOFFFLG	02A6	798	799	946↕
XON	0011	685↕		

```
                    003    (RBIOS)

66
67                  ;*****************************************************************
68                  ;*****************************************************************
69                  ;********                                               ********
70                  ;********       EXTERNAL DEFINITIONS                    ********
71                  ;********                                               ********
72                  ;*****************************************************************
73                  ;*****************************************************************
74                  ;
75                  ;
76                  ;
77
78
79                          EXTRN   HSTDSK,HSTTRK,HSTSEC
80                          EXTRN   MULT,PMAADR,NBRFLEX,DSKCMD
81                          EXTRN   ERRBUF
82                          PAGE



                    004    (RBIOS)

83
84                  ;*****************************************************************
85                  ;*****************************************************************
86                  ;********                                               ********
87                  ;********       ENTRY DEFINITIONS                       ********
88                  ;********                                               ********
89                  ;*****************************************************************
90                  ;*****************************************************************
91                  ;
92                  ;
93                  ;
94
95
96                          PUBLIC  WINDRW,WINDRE,WINDFM,DESLCT
97
98
99
100                         PAGE
```

```
                ; WINCHESTER DISK DEFINITIONS
                ; ============================
                ;
                ;
0CC0 =          HBASE   EQU     0C0H    ;CONTROLLER BASE ADDR.
0CC0 =          DATA    EQU     HBASE   ; R/W DATA REGISTER
0CC1 =          ERROR   EQU     HBASE+1 ; R   ERROR REGISTER
0CC1 =          WPC     EQU     HBASE+1 ;   W WRITE PRECOMPENSATION REGISTER
0CC2 =          SECNT   EQU     HBASE+2 ; R/W SECTOR COUNT REGISTER FOR FORMAT COMM.ONLY
0CC3 =          SECNO   EQU     HBASE+3 ; R/W SECTOR NUMBER REGISTER
0CC4 =          CYLLO   EQU     HBASE+4 ; R/W CYLINDER LOW REGISTER
0CC5 =          CYLHI   EQU     HBASE+5 ; R/W CYLINDER HIGH REGISTER
0CC6 =          SDH     EQU     HBASE+6 ; R/W BYTES PRE SECTOR / DRIVE # / HEAD # /
0CC7 =          STATUS  EQU     HBASE+7 ; R   STATUS REGISTER
0CC7 =          COMMD   EQU     HBASE+7 ;   W COMMAND REGISTER
                ;
0000 =          STRATE  EQU     0       ;STEPING RATE TRACK TO TRACK = BUFFERED STEP
                ;
                ;
0010 =          REST    EQU     10H OR STRATE ;RESTORE COMMAND WITH STRATE
0070 =          SEEK    EQU     70H OR STRATE ;SEEK COMMAND WITH STRATE
0020 =          READ    EQU     20H           ;READ COMMAND
0022 =          READL   EQU     22H           ;READ LONG
0030 =          WRITE   EQU     30H           ;WRITE COMMAND
0032 =          WRITEL  EQU     32H           ;WRITE LONG
0050 =          FORMAT  EQU     50H           ;FORMAT COMMAND
                ;
                ;
                ; ****************************************
                ; ***   ERRROR REGISTER EQUATES    ***
                ; ****************************************
                ;
0001 =          DAMNFD  EQU     01H         ; ADDR. MARK NOT FOUND
0002 =          TR0     EQU     02H         ; TRACK 0 ERROR
0004 =          ABC     EQU     04H         ; ABORTED COMMAND
0010 =          IDNFD   EQU     10H
0020 =          CRCID   EQU     20H         ; CRC-ERROR  ID-FIELD
0040 =          UNCOR   EQU     40H         ; UNCORRECTED DATA IN DATA FIELD
0080 =          BBD     EQU     80H         ; BAD BLOCK DETECTED
                ;
                ; ************************************
                ; ***   STATUS REGISTER EQUATES    ***
                ; ************************************
                ;
0001 =          CERR    EQU     01H         ; CONTROLLER ERROR .
0004 =          CORRD   EQU     04H         ;DATA CORRECTED IN DATA FIELD (ECC)
0008 =          CDRQ    EQU     08H         ; CONTROLLER DATA REQUEST
0010 =          DSEEC   EQU     10H         ; DRIVE SEEK COMPLETE
0020 =          DWRFA   EQU     20H         ; DRIVE WRITE FAULT
0040 =          DREADY  EQU     40H         ; DRIVE READY
0080 =          CBUSY   EQU     80H         ; CONTROLLER BUSY
                ;
                ;       ERROR CODES
                ;
```

```
                        006    (RBIOS)

157   0068 =            NTRDY   EQU     00068H          ; NOT READY
158   95C0 =            FATER   EQU     095C0H          ; FATAL ERROR
159   20C0 =            IOER    EQU     020C0H          ; I/O ERROR
160                     ;
161                     ;       MISC EQU
162                     ;
163   0002 =            UNIT1   EQU     02H             ; UNIT SELECT
164   0080 =            ECC     EQU     80H             ; ECC INDICATOR
165   0020 =            SECSIZ  EQU     20H             ; SECTOR SIZE = 512 BYTES/SECTOR
166   0001 =            HEAD1   EQU     01H             ; HEAD INDICATOR
167   0018 =            DRIVE4  EQU     18H             ; DRIVE 4 INDICATOR
168                               PAGE

                        007    (RBIOS)

169
170
171                     ;*****************************************************************
172                     ;*****************************************************************
173                     ;********                                             ********
174                     ;********       HARD DISK DRIVER                      ********
175                     ;********                                             ********
176                     ;*****************************************************************
177                     ;*****************************************************************
178                     ;
179                     ;
180                     ;
181                     ;*****************************************************************
182                     ;*                                                               *
183                     ;*      WINDRE  RESTORE HARD DISK                                *
184                     ;*                                                               *
185                     ;*****************************************************************
186
187                                     F51F
188                     WINDRE:
189   0000 3E10                 MVI     A,REST
190   0002 C5                   PUSH    B               ; DUMMY PUSH
191   0003 C31700               JMP     WINMAIN         ; GO TO HARD DISK MAIN ROUTINE
192
193
194
195
196                     ;*****************************************************************
197                     ;*                                                               *
198                     ;*      WINDFM  FORMAT TRACK                                     *
199                     ;*                                                               *
200                     ;*****************************************************************
201
202                     WINDFM:
203   0006 3E50                 MVI     A,FORMAT
204   0008 C5                   PUSH    B               ; DUMMY PUSH
205   0009 C31700               JMP     WINMAIN         ; GOTO MAIN ROUTINE
206
207
208                               PAGE
```

```
                        008    (RBIOS)

209
210
211                     ;*****************************************************************
212                     ;*                                                               *
213                     ;*      WINDRW  READ OR WRITE ENTRY POINT                        *
214                     ;*                                                               *
215                     ;*****************************************************************
216
217                     WINDRW:
218   000C 3A0000               LDA     DSKCMD
219   000F B7                   ORA     A
220   0010 3E30                 MVI     A,WRITE         ;WRITE COMMAND
221   0012 CA1700               JZ      WINMAIN         ;JUMP IF A WRITE COMMAND REQ.
222   0015 3E20                 MVI     A,READ          ;READ COMMAND
223                     WINMAIN:
224   0017 32E800               STA     FUNCT           ; SAVE FUNCTION
225   001A 210000               LXI     H,0
226   001D 220000               SHLD    ERRBUF          ;RESET ERROR STATUS
227
228
229                               PAGE


                        009    (RBIOS)

230
231                     ;
232                     ;  ***  CHECK IF DRIVE READY  ***
233                     ;
234                     FIXD1:
235   0020 3EAA                 MVI     A,0AAH
236   0022 D3C4                 OUT     CYLLO           ;CHECK IF DRIVE IS UNDER POWER
237   0024 3E55                 MVI     A,055H
238   0026 D3C3                 OUT     SECNO
239   0028 DBC4                 IN      CYLLO
240   002A FEAA                 CPI     0AAH
241   002C C23600               JNZ     FIXNDR          ;JUMP IF NOT READY
242   002F DBC3                 IN      SECNO
243   0031 FE55                 CPI     055H
244   0033 CA3C00               JZ      FIXD2           ; JUMP IF READY
245                     FIXNDR:
246   0036 216800               LXI     H,NTRDY         ; HL - ERROR MESSAGE
247   0039 C3C000               JMP     ER2
248                               PAGE
```

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                    010    (RBIOS)

249
250                 FIXD2:
251   003C 3A0000           LDA     HSTSEC          ; GET SECTOR NUMBER
252   003F 3D               DCR     A               ; START SECTOR = 0
253   0040 D3C3             OUT     SECNO           ; SET SECTOR NUMBER
254   0042 3A0000           LDA     HSTDSK
255   0045 210000           LXI     H,NBRFLEX
256   0048 96               SUB     M
257   0049 47               MOV     B,A             ; SAVE UNIT NUMBER
258   004A 07               RLC
259   004B 07               RLC
260   004C E618             ANI     18H
261   004E 4F               MOV     C,A             ; SAVE DRIVE NUMBER
262   004F 78               MOV     A,B             ; GET UNIT NUMBER
263   0050 1F               RAR
264   0051 3E00             MVI     A,0
265   0053 D25800           JNC     FIXD3           ; JUMP IF EVEN DRIVE NUMBER REQUESTED
266   0056 3E02             MVI     A,UNIT1         ; DRIVE 1 REQ. HEAD 2 + 3
267                 FIXD3:
268   0058 B1               ORA     C               ; COMBINE WITH DRIVE NUMBER
269   0059 F6A0             ORI     ECC OR SECSIZ   ; SET ECC AND SECTOR SIZE
270   005B 47               MOV     B,A
271   005C 2A0000           LHLD    HSTTRK          ; GET TRACK
272   005F 7D               MOV     A,L
273   0060 1F               RAR
274   0061 3E00             MVI     A,0
275   0063 D26900           JNC     FIXD4           ; JUMP IF TRACK NUMBER EVEN (HEAD = 0)
276   0066 2B               DCX     H               ; CORRECT TRACK NUMBER FOR LATER
277   0067 3E01             MVI     A,HEAD1
278                 FIXD4:
279   0069 B0               ORA     B               ; COMBINE SDH
280   006A D3C6             OUT     SDH             ; SET HEAD DRIVE SEC. SIZE AND ECC
281   006C DBC7             IN      STATUS
282   006E E650             ANI     DREADY OR DSEEC
283   0070 FE50             CPI     DREADY OR DSEEC
284   0072 C23600           JNZ     FIXNOR          ; JUMP IF DRIVE NOT READY
285   0075 7C               MOV     A,H
286   0076 1F               RAR
287   0077 D3C5             OUT     CYLHI           ; SET CYLINDER HIGH
288   0079 7D               MOV     A,L
289   007A 1F               RAR
290   007B D3C4             OUT     CYLLO           ; SET CYLINDER LOW
291   007D 3AE800           LDA     FUNCT           ; GET FUNCTION
292   0080 D3C7             OUT     COMND           ;SET FUNCTION
293   0082 E6F0             ANI     0F0H
294   0084 FE20             CPI     READ            ;READ
295   0086 CA9600           JZ      RD
296   0089 FE30             CPI     WRITE           ;WRITE
297   008B CACF00           JZ      WR
298   008E FE50             CPI     FORMAT          ;FORMAT
299   0090 CAC800           JZ      WR0
300   0093 C30A00           JMP     WR2             ; SEEK OR RESTORE
301                       PAGE
```

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                        011    (RBIOS)

302
303                     ;*****************************************************************
304                     ;READ ROUTINE
305                     ;*****************************************************************
306                     RD:
307   0096 0EC0                 MVI     C,DATA          ; PORT ADDRESS
308   0098 0600                 MVI     B,00H           ; TRANSFER LENGTH =256
309   009A 2A0000               LHLD    PMAADR          ; GET BUFFER ADDRESS
310   009D CDAA00               CALL    WAIT            ; WAIT UNTIL CONTROLLER FINISHED
311                     RD2:
312                             INIR
313   00A0+EDB2                 DB      0EDH,0B2H
314       +                     ENDM
315                             INIR
316   00A2+EDB2                 DB      0EDH,0B2H
317       +                     ENDM
318   00A4 CDE300               CALL    DESLCT          ; DESELECT REQ. DRIVE
319   00A7 C1                   POP     B               ; RETRY AND RESTORE COUNTER
320   00A8 AF                   XRA     A               ; RETURN GOOD STATUS
321   00A9 C9                   RET
322                             PAGE


                        012    (RBIOS)

323
324                     ;*****************************************************************
325                     ;WAIT ROUTINE
326                     ;*****************************************************************
327   00AA DBC7         WAIT:   IN      STATUS
328   00AC A7                   ANA     A
329   00AD FAAA00               JM      WAIT            ;JUMP IF CONTROLLER BUSY
330   00B0 1F                   RAR
331   00B1 D0                   RNC                     ;RETURN IF NO ERROR
332                     ;
333                     ;
334   00B2 DBC1         ER1:    IN      ERROR
335   00B4 E1                   POP     H               ;RESTORE RETURN ADDRESS
336   00B5 21C020               LXI     H,IOER
337   00B8 E660                 ANI     CRCID OR UNCOR
338   00BA C2C000               JNZ     ER2             ;JUMP IF I/O ERROR
339   00BD 21C095               LXI     H,FATER         ;FATAL ERROR
340                     ER2:
341   00C0 220000               SHLD    ERRBUF          ;SET ERROR FOR ERROR-HANDLER
342   00C3 CDE300               CALL    DESLCT          ;DESELECT REQ. DRIVE
343   00C6 C1                   POP     B               ;RESTORE RETRY COUNTER
344   00C7 3EFF                 MVI     A,0FFH
345   00C9 B7                   ORA     A               ;SET ERROR FLAG
346   00CA C9                   RET
347                             PAGE
```

```
                        013    (RBIOS)

348
349                     ;*************************************************************
350                     ;WRITE ROUTINE
351                     ;*************************************************************
352   00C8 3E11         WR0:    MVI     A,17
353   00CD D3C2                 OUT     SECNT           ; SET SECTOR COUNT FOR FORMAT
354                     WR:
355   00CF 0EC0                 MVI     C,DATA          ; PORT ADDRESS
356   0001 0600                 MVI     B,00H           ; TRANSFER LENGTH = 256
357   0003 2A0000               LHLD    PMAADR          ;BUFFER ADDR.
358                     WR1:
359                               OTIR
360   00D6+ED83                 DB      0EDH,0B3H
361       +                     ENDM
362                               OTIR
363   00D8+EDB3                 DB      0EDH,0B3H
364       +                     ENDM
365   00DA CDAA00       WR2:    CALL    WAIT            ; WAIT UNTIL CONTROLLER READY
366   00DD CDE300               CALL    DESLCT          ; DESELECT REQ. DRIVE
367   00E0 C1                   POP     B               ; RESTORE RETRY COUNTERS
368   00E1 AF                   XRA      A              ; SET GOOD STATUS
369   00E2 C9                   RET
370
371                               PAGE


                        014    (RBIOS)

372
373                     ;*************************************************************
374                     ;*                                                           *
375                     ;*      DESLCT  DESELECT REQ. DRIVE AND SELECT DRIVE 4       *
376                     ;*                                                           *
377                     ;*************************************************************
378
379
380                     DESLCT:
381   00E3 3EB8                 MVI     A,ECC OR SECSIZ OR DRIVE4
382   00E5 D3C6                 OUT     SDH             ; SELECT DRIVE 4
383   00E7 C9                   RET
384
385
386
387
388
389
390
391   00E8 00           FUNCT:  DB      0               ;FUNCTION BYTE
392   00E9                       END
```

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                        016    (RBIOS)

SECSIZ          0020    165#  269   381
SEEK            0070    123#
STATUS          00C7    116#  281   327
STRATE          0000    119#  122   123
TRO             0002    136#
UNCOR           0040    140#  337
UNIT1           0002    163#  266
WAIT            00AA    310   327#  329   365
WINDFM          0006     96   202#
WINDRE          0000     96   188#
WINDRW          000C     96   217#
WINMAIN         0017    191   205   221   223#
WPC             00C1    110#
WR              00CF    297   354#
WR0             00C8    299   352#
WR1             00D6    358#
WR2             00DA    300   365#
WRITE           0030    126#  220   296
WRITEL          0032    127#
!
```

CP/M-80 BIOS LINKLIST

BTRECS	EAFD	DSKSLC	E5B9	LISTST	EC7D	SEKDSK	EAD8
CHECKO	E8E9	DSKTRK	E605	M1RS23	E010	SECSET	E73C
CINIT	EBF5	DSKTYP	E631	M2RS23	E011	SEKHST	EB09
CLOSE	E4FB	DTRKSE	E741	MODCRT	ECC7	SEKSEC	EADB
CLRLI1	F1F6	ERFLAG	EB0A	MOVE	DFE4	SEKTRK	EAD9
CLRLIN	DE3C	ERRBUF	EAED	MOVEL	DFEA	SIOINI	F53B
CMPRE	E65D	FATERR	E288	MULT	DFC2	SRLCOV	F5BB
COMBLO	EAE4	FIXINI	E562	NBRFLE	E00A	SRLIN	F5B2
COMPDE	DFF4	FLUSH	E4F0	NOTRDY	E236	SRLINS	F56C
CONFIG	E00F	FNERRM	E29F	NRDYRX	E247	SRLOUT	F550
CONIN	EC2F	FNTBLN	E115	OFST	E64C	SRLSTA	F55E
CONOUT	EC3D	FORMAT	E6B3	PIOINI	F5C5	STBIOS	DE00
CONST	EC21	FREAD	E6AB	PMAADR	EB02	SUBHLD	DFF0
CREAD	E69C	FUNNCH	F443	POPREG	ECC3	TMPCOL	F33D
CRTTBL	E116	FUNTBL	E015	PRTOUT	F5D0	TRANS	F34B
CURCOL	F33B	FWRITE	E6A4	PRTSTA	F5DA	TRKSET	E735
CWRITE	E695	GETLPO	F423	PUNCH	EC4B	TRNCHR	EEA0
DESLCT	EBEF	HSTACT	EB07	PVRS23	E013	TRNSPC	EEA7
DHOME	E83E	HSTDSK	EAE0	RDTRAK	E6EC	UNACNT	EAFF
DISKIO	E671	HSTSEC	EAE3	READER	EC5D	UNADSK	EADC
DISPER	DE39	HSTTRK	EAE1	READID	E87E	UNASEC	EADF
DMAADR	EB00	HSTWRT	EB08	READOP	E805	UNATRK	EADD
DMASET	E717	IOBSET	E00B	READSE	E897	WBOTE	DE03
DRQ	F341	IOERRM	E273	RESET	E9F0	WINDFM	EB12
DRQADR	F343	KBDINI	F34C	RETRYC	E00C	WINDRE	EB0C
DSKCMP	EAFE	KEYST	F39A	ROUTE	EC8D	WINDRW	EB18
DSKERR	EA01	KEYTBL	E1EE	RSFLAG	EB04	WINIT	EC0B
DSKGET	E552	KEYIN	F3A3	RSTC	E00D	WRCUPO	F2E2
DSKMSC	E60D	LANGUA	F34A	SACTIV	F5EE	WRPRCT	E25A
DSKSET	E71C	LIST	EC6D	SAVESE	EB08	WRTYPE	EB06
DSKSID	E5B5						

In the special version of the operating system for Arabic, all BIOS sections except MBIOS are located 4KB lower in memory than indicated by the BIOS linklist. The same is true of the version of the operating system supporting the Dead-Key facility, with the difference that these BIOS sections are located 2KB lower than indicated by the linklist.