CP/M-80 R2.2 for the Epson QX-10 System

External Reference Specification

256K -- Version B2.20

CONTENTS

1.0   INTRODUCTION

This document describes the external features and characteristics of an implementation of the Digital Research Inc. CP/M-80 R2.2 operating system for the Epson QX-10 microcomputer. This version of the Specification reflects the 256K version of CP/M-80 R2.2 designated by Epson as release level B2.20.

The operating system product resulting from this implementation includes:

A system data page. The purpose of the data page is to provide specific locations on the system tracks for specific supported features. This eliminates the need to move code around to compensate for system changes. See Appendix G for an illustration of the System Data Page.

A customized Basic Input/Output System (BIOS), integrated with the unmodified CCP and BDOS components of CP/M-80.

A stand-alone utility program called SETUP which is used to establish and/or modify the characteristics of the system configuration.

A stand-alone utility program called COPYDISK which is used to format and copy floppy diskettes.

A Reference Manual which supplements the Digital Research CP/M-80 documentation and describes to the user the unique features and facilities of this implementation and how it is used.

Source code listings of the customized BIOS and utilities.

A detailed specification of the product (this document) which when used in conjunction with the source listings provides the necessary documentation to support program maintenance.

The Requirements used in developing this specification were taken from the CP/M-80 Version 2.2 documentation provided by Digital Research, the QX-10 technical specifications and marketing requirements provided by Epson America, Inc. This implementation is designed to support the various QX-10 system configuration options which include floppy disks, printers, video display, keyboard, memory and serial ports.

The objective of this implementation is to provide application program access to the various hardware

4

facilities of the QX-10 microcomputer system with a user-friendly interface, while providing the functionality of CP/M-80 and its large applications software base to the Epson QX-10 System customer base.

2.0   APPLICABLE DOCUMENTS

The following documents are relevant to this customization:

CP/M Operating System Manual by Digital Research

QX-10 Firmware Specifications - Revision C1 (July 10,1982)

QX-10 System Specification - Revision C5

QX-10 Technical Manual - Principles of Hardware Operation

Operator's Manual Models 912/920 by Televideo Systems Inc.

3.0   FEATURE DESCRIPTION

3.1   DEVICE ASSIGNMENTS

3.1.1   GENERAL DESCRIPTION

The following tables provide the required correlation for the CP/M-80 logical devices, CP/M-80 physical devices and the QX-10 physical devices.

Table 1-1   Device Correspondence

CP/M-80 Physical Device	QX-10 Physical Device
CRT:	Input = Keyboard
	Output = Video Display
PTR:	Input = Keyboard
PTP:	Output = Video Display
LPT:	Parallel Printer Port
TTY:	Video Display
UC1:	Serial Port
UR1:	Serial Port
UR2:	Serial Port
UP1:	Serial Port
UP2:	Serial Port
UL1:	Serial Port
BAT:	Input = Current RDR Setting
	Output = Current LST Setting

Table 1-2 Permitted Logical to Physical Assignments

CP/M Logical Device Name		CP/M Physical Devices			
CON:	=	TTY:	CRT:	BAT:	UC1:
RDR:	=	TTY:	PTR:	UR1:	UR2:
PUN:	=	TTY:	PTP:	UP1:	UP2:
LST:	=	TTY:	CRT:	LPT:	UL1:

NOTE: Table 1-2 is established within CP/M-80 itself and is not created or modified by this implementation of CP/M-80

3.1.2   USER/OPERATOR INTERFACES

To display the current assignments in effect, or to make changes in the assignments, the User utilizes the various options contained in the CP/M-80 STAT command.   The command STAT DEV: displays the current assignments in effect for the four CP/M-80 logical device names: CON:, RDR:, PUN: and LST:.   The command STAT VAL: displays the possible CP/M physical device names that the User can assign to each CP/M logical device name as defined in Table 1-2 above. The SETUP program stores the current value of the IOBYTE in the system data page.   This feature allows the User to establish a defined configuration which is restored at each cold boot.

3.1.3   ABORTS AND RECOVERIES

None.

3.1.4   ERRORS

None.

3.1.5   PERFORMANCE

Nominal.

3.1.6   OPERATIONAL CONSIDERATIONS

The QX-10 physical device assignments shown in Table 1-1 are implemented as part of the BIOS customization. The IOBYTE is a reserved byte in memory that keeps track of logical-to-physical device assignments. Display of the possible IOBYTE

assignments (Table 1-2) and the current values in effect
along with modification of the values in effect is
accomplished through the standard CP/M-80 STAT utility which
has not been modified for this implementation.

3.2   VIDEO DISPLAY CONSOLE

The Epson QX-10 product line makes two video display boards
available to the end user. The Monochrome Video Board
(standard equipment) is equipped with a character generator.
The Color Video Board (optional equipment) supports color
display but does not have an on-board character generator.
The availability/lack of a character generator imposes
different requirements to the software video driver code.

3.2.1   CHARACTER DRIVER

3.2.1.1   GENERAL DESCRIPTION

The Epson QX-10 System Video Display Unit has a 25 line by
80 character display screen with a variety of special
features. Since there is no standard Interface for CP/M-80
system video terminals, a serial TTY interface is emulated
by the BIOS console routines with software controllable
ESCAPE and CONTROL sequences allowing selection of the
special features.

The terminal emulation in the BIOS is table driven so that
emulation of various terminals can be adopted without major
impact on the software.

A 24 line by 80 character User screen is supported. Line 25
is reserved for BIOS error and status messages. Line 25
displays a continuous status line indicating the current
date-and-time (optional) plus the appropriate BIOS error
messages as they occur. Additionally, the following
selectable features are supported.

        high/low intensity
        reverse video
        blinking field
        auto line wrap
        blinking/non-blinking cursor
        date and time display
        bit 7 masking

The terminal emulation is the Televideo 920 (TVI-920)
Terminal. The emulation of the TVI-920 allows an application
program, through the use of an established set of escape
sequences, to control the display screen independent of the
actual memory mapped screen implementation. On entry to the
character output routines, the special sequences are checked

and emulated according to the TVI-920 specification (refer to Appendix C).

3.2.1.2   USER/OPERATOR INTERFACES

The configuration utility (SETUP) described in section 3.8 is used to select features such as auto line wrap, date and time display, bit 7 masking and cursor format. If none of the special screen features are exercised, then the user program has a basic serial TTY interface presented. The standard TTY interface is any printable ASCII character plus Bell, Backspace, Tab, Line Feed, and Carriage Return.

3.2.1.3   ABORTS AND RECOVERIES

Any unrecognized Escape sequence is ignored by the console routines.

3.2.1.4   ERRORS

None.

3.2.1.5   PERFORMANCE

Since the Video Display on the QX-10 System is controlled by the NEC 7220 GDC, the terminal speed is somewhat impacted when compared to a true TVI-920's performance. Degradaton is dependent upon which features of the TVI-920 are being utilized.

3.2.1.6   OPERATIONAL CONSIDERATIONS

Line 25 is reserved for a system status line and is not part of the emulation. System error messages are cleared from line 25 by either correcting the indicated condition or by taking alternative action. The error messages and response alternatives are described in Appendix B.

The display terminal implemented is memory mapped into any 4K block of the 128K of RAM devoted to the video display. This 128K of RAM is in addition to the 256K of RAM available from main memory. This allows graphic application programs to use a separate area of the video RAM without interference.

3.2.2   GRAPHICS (MULTI-FONT) DRIVER

3.2.2.1   GENERAL DESCRIPTION

The Epson QX-10 System Video Display Unit has a 25 line by
80 character display screen with a variety of special
features.   Since there is no standard Interface for CP/M-80
system video terminals, a serial TTY interface is emulated
by the BIOS console routines with software controllable
ESCAPE and CONTROL sequences allowing selection of the
special features.

The terminal emulation in the BIOS is table driven so that
emulation of various terminals can be adopted without major
impact on the software.

A 24 line by 80 character User screen is supported. Line 25
is reserved for BIOS error and status messages.   Unlike the
Character Driver, the Graphics Driver is unable to continu-
ously display a status line on CRT's 25th line   A status
line is maintained internally but is only displayed upon
operator request.   As with the character driver, the
messages displayed in the status line indicate the current
date-and-time (optional) plus the appropriate BIOS error
messages as they occur.   Additionally,   the following
selectable features are supported.

        high/low intensity
        reverse video
        underline
        auto line wrap
        blinking/non-blinking cursor
        cursor mask
        bit 7 masking

The terminal emulation is the Televideo 920 (TVI-920)
Terminal. The emulation of the TVI-920 allows an application
program, through the use of an established set of escape
sequences, to control the display screen independent of the
actual memory mapped screen implementation. On entry to the
character output routines, the special sequences are checked
and emulated according to the TVI-920 specification (refer
to Appendix C).

3.2.2.1.1 STANDARD ATTRIBUTES

The graphics mode of the video display board does not allow
for the use of the character attributes (e.g. hi-lite,
reverse, blink, and secret).   To provide as much TVI-920
compatability as possible, the following considerations have
been taken:

HIGHLIGHT   -- Different intensities are not possible in
        graphics mode.   Highlight will be emulated by using a
        BOLD font in place of the standard font.   If an

optional font (italic or style) is being used, the bits to the right of an ON bit will also be set ON. This creates a psuedo bold font from any given font.

REVERSE   – Reverse video will be accomplished by complementing all bits within the reverse field. This results in an exact emulation.

BLINK and SECRET – These attributes are not practical in a graphics mode driver. These attributes will have no effect but will result in a space (blank) being written in their place. This is to keep the same cursor positioning relative to the TVI-920.

UNDERLINE   – This attribute is not possible in the character mode driver. The graphics driver will emulate the underline field by setting ON the bits in the 15 th pixel row of the character font.

3.2.2.1.2 EXTENDED ATTRIBUTES

The graphics mode allows some extended capabilities. These features have been added as mode attributes invoked with ESC sequences and extended BIOS calls (refer to Section 3.12 and Appendix C) and provide the following functions:

SET FONT – This sets the current font to one of 6 fonts (0-5). See multiple fonts (3.2.2.4) for additional information.

LOAD FONT – This function allows the user to specify a particular (custom) font to be used in place of the current font. See multiple fonts (3.2.2.4) for additional information.

SUBSCRIPT – This mode begins writting data on the screen in subscript mode.

SUPERSCRIPT – This mode begins writting data on the screen in superscript mode.

NORMALSCRIPT – This mode resets the superscript and sub-script modes back to normal mode.

FOREGROUND COLOR – This sets the current foreground color to the selected color (0-7).

BACKGROUND COLOR – This sets the current background color to the selected color (0-7).

Televideo Escape Sequences for Reverse Video and Underline are field attributes. The following escape commands provide

10

the Reverse Video and Underline attributes as mode (toggle) attributes without the overhead of requiring a field position on the video display.

SET REVERSE VIDEO - Enter Reverse Video mode.

RESET REVERSE VIDEO - Exit Reverse Video mode.

SET UNDERLINE - Enter Underline mode.

RESET UNDERLINE - Exit Reverse Video mode.

3.2.2.3 MULTIPLE FONTS

Six fonts are accessible to the graphics driver at any one time. These fonts are initialized as follows:

FONT	NAME
0	STANDARD (8-bit)
1	STANDARD/BOLD (7-bit)
2	ITALIC (7-bit)
3	ITALIC/BOLD (7-bit)
4	STYLE (custom) (7-bit)
5	STYLE/BOLD (7-bit)

The STANDARD font is identical to the ROM character generater font and includes all 192 displayable characters (characters 0-1FH and 80H-9FH are not displayable).

The ITALIC font is a 7-bit ASCII character set in an italics style.

The STYLE or custom font is completely user definable and includes the 96 characters in the 7-bit ASCII set. It may be set to any 96 character configuration. The font must be a standard sized matrix.

The BOLD fonts are a bold or broadened version of the currently selected font but only include the 7-bit ASCII character set.

The current font may be set in two ways. Any application program may send the appropriate ESCape sequence to set the current font, or the user may change the current font with the special function keys on the HASCI keyboard.

HASCI KEY   FUNCTION

11

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BOLD              Toggle (set off if on, set on if off) Hi-lite
ITALIC            Toggle font between italic and standard font.
SIZE              Reserved for future use.
STYLE             Toggle font between style and standard.
```

Although the BOLD key does not set the font to bold or 1, it
provides the same function by the following action.   If the
hi-lite mode is on, and the current font is 0 or 1, and the
character is 7 bit then font 1 or the bold font is used.
This allows the operator to use a bold italics or a bold
style or custom font simple by using the keys on the
keyboard.

An application may also set ANY font to a custom font of its
own choosing.   The application first sets the current font
number to the font to be overlaid, and then performs the
extended BIOS call to overlay the font.   Font 0 may be any
8-bit font, fonts 1-5 must be a 7-bit font.

3.2.2.2   USER/OPERATOR INTERFACES

The   configuration utility (SETUP) described in section 3.8
is used to select features such as auto line wrap,   bit 7
masking and cursor format.   If none of the special screen
features are exercised,   then the user program has a basic
serial TTY interface presented.   The standard TTY interface
is any printable ASCII character plus Bell, Backspace, Tab,
Line Feed, and Carriage Return.

3.2.2.3   ABORTS AND RECOVERIES

Any unknown Escape sequence is ignored by the console
routines.

3.2.2.4   ERRORS

None.

3.2.2.5   PERFORMANCE

Since the Video Display on the QX-10 System is controlled by
the NEC 7220 GDC, the terminal speed is somewhat impacted
when compared to a true TVI-920's performance.   Degradaton
is dependent upon which features of the TVI-920 are being
utilized.

3.2.2.6   OPERATIONAL CONSIDERATIONS

Line 25 is reserved for a system status line and is not part

12
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of the emulation. Example error messages are cleared from line 25 by either correcting the indicated condition or by taking alternative action. The error messages and response alternatives are described in Appendix B.

The display terminal implemented is memory mapped with 32000 bytes of the 128K of video RAM devoted to the terminal display. This 128K of RAM is in addition to the 256K of RAM available from main memory.

## 3.3    KEYBOARD SUPPORT

### 3.3.1    GENERAL DESCRIPTION

At the option of the User either the production or earlier HASCI keyboard is supported as the CP/M-80 R2.2 console input device. Keys such as Escape, Caps Lock, Control, Graph Shift and all typamatic keys are supported by the BIOS console routines. The BIOS maintains a 128 character type-ahead buffer regardless which keyboard is selected.

### 3.3.2    USER/OPERATOR INTERFACES

Keyboard options, such as typamatic keys or which keyboard is connected to the system, are handled by the configuration utility (SETUP) described in section 3.8. The B Release of CP/M-80 supports two keyboards--HASCI 1 and HASCI 2. The HASCI 2 keyboard has one function key, EDIT, that is not available on the HASCI1 keyboard. The keypads of the two keyboards do not correspond. (See keyboard diagrams in the appendix for specific differences.)

### 3.3.3    ABORTS AND RECOVERIES

None

### 3.3.4    ERRORS

None

### 3.3.5    PERFORMANCE

The BIOS manages the 128 character type-ahead buffer feature by running the keyboard in interrupt mode rather than using the normal polling technique.

### 3.3.6    OPERATIONAL CONSIDERATIONS

The keyboards supported by this implementation produce scan
codes which must be mapped into the desired characters. The
design of the keyboard mapping is table driven and does not
preclude the support for other keyboard types which may be
made available during later phases of the QX-10 product
cycle.


The translated scan codes produce the full range of 8-bit
characters (0-255) enabling generation of graphics charac-
ters. The Epson product line (QX-10, HX-20 and printer
products) support a variety of graphics character sets.
Therefore, flexiblity is provided at system generation time
to link the particular keyboard tables which translate the
proper video driver-keyboard-printer combination accurately.

The character video driver is only able to produce the QX-10
graphics character set on the console. The ideally suited
keyboard tables will support the graphics characters in a
manner similar to the unshifted and shifted graphics
keyboard mappings as implemented in the Valdocs scheme.

The graphics video driver has the flexiblity of being able
to display more than one font on the console. Therefore,
the driver can support a variety of graphics character sets
generated by the keyboard or supported by a printer.
Support of the RX product is acheived on the QX by
combining the graphics video driver linked with the RX font,
and the keytables which generate the graphics set supported
by the RX.

The hexidecimal keyboard mapping which generates the QX font
is listed for each keyboard in Appendix A.

When a keyboard is selected via SETUP, the keyboard in
effect is displayed as part of the CP/M "sign-on" message at
either the next power-on or at the next system reset.


3.4      PRINTER SUPPORT


3.4.1    GENERAL DESCRIPTION

The Epson MX, FX and RX series printers, connected via the
parallel interface, are supported by the customized BIOS.
Other printers can be connected if they follow the industry
standard Centronics compatible parallel interface or the RS-
232C serial interface and one of the handshaking protocols
supported by the BIOS serial support options described in
section 3.7.


In the case where Epson printers are connected to the QX-10
via the parallel port, specific support can be identified in

the SETUP utility.   Note: this support is limited to proper
status byte interpretation.   Printer identification through
SETUP  does  not affect the video driver - keyboard  mapping
configuration.


## 3.4.2   USER/OPERATOR INTERFACES

Support for the printers is limited to the basic BIOS calls,
configuration  management and error recovery.   Support  for
the various printer special features is the responsibilty of
the application software.


## 3.4.3   ABORTS AND RECOVERIES

Error  reporting and error retry options are made  available
to  Epson printers connected to the parallel  port  provided
that  proper  printer  selection is declared via  the  SETUP
utility.   If a non-Epson printer is utilized or the printer
is  connected to the serial port,  aborts and recoveries are
the responsibilty of the application software.


## 3.4.4   ERRORS

Errors are reported to the user on line 25.   An explanation
of the error messages is contained in Appendix B.


## 3.4.5   PERFORMANCE

As  described in the specific printer  model  documentation,
printers connected to the serial port cannot be supported at
speeds  greater than 1200 baud without making changes to the
jumper  options  inside  the  QX-10  itself  when  hardware
handshaking  is used.  Refer to the QX-10 Technical  Manual,
Principles of Hardware Operations,  page 4-32, Table 4-8 for
data relating to the jumpers.


## 3.4.6   OPERATIONAL CONSIDERATIONS

The  assignment  of  the  List Device for  CP/M-80  R2.2  is
accomplished by the logical device assignment option of STAT
as  described  in section 3.1.   The  selection  of  printer
options  and  handshaking  methods are handled by  SETUP  as
described in section 3.8.


## 3.5      DISK SUBSYSTEMS SUPPORT

The  BIOS provides support for two standard disk  subsystems
on  the  QX-10:   Floppy diskette subsystem and a  RAM  disk

subsystem occupying two of the 64K memory banks.    Optional-
ly,  the  BIOS provides support for a winchester  disk  sub-
system.


## 3.5.1    FLOPPY DISK SUBSYSTEM


### 3.5.1.1    GENERAL DESCRIPTION

The BIOS supports the two intergal 5 1/4" double-sided  disk
drives.   The standard disk format for this implementation is
512  Byte sectors with 10 sectors per track.   Provision  is
made  in  the  BIOS to read or write (not  format)  industry
standard  diskette  formats from the  RIGHT  drive.  Utility
programs  are available which allow the User to  reconfigure
the  RIGHT drive to allow for the importing  of  application
software from other systems.

The BIOS writes all filled or partially filled write buffers
to disk in the following situations:

1.   Write operation to the directory.
2.   Warm Boot

This  version  of the implementation can support other  disk
formats  as  well  as the standard QX-10  format  described
above.   The specific data for the QX-10 format and supported
optional formats is given in Appendix D.


### 3.5.1.2    USER/OPERATOR INTERFACES

In order to read or write files from diskettes recorded in a
supported  optional  format,  the User must select  the  the
format from the SETUP utility.   After the utility has  been
run, the BIOS can read or write these diskettes only in  the
RIGHT drive.   After reading the desired diskette, and before
attempting to read standard QX-10 formatted  diskettes,  the
User  must reselect the QX-10 format with the SETUP utility.
The  QX-10  format is always in effect after a power-on or a
system reset.   Once the RIGHT drive has been alterred by the
SETUP  utility  it remains in effect through  a  warm  start
(CONTROL C).


### 3.5.1.3    ABORTS AND RECOVERIES

Error reporting and error retry options are available to the
User  and  are  selectable from the  SETUP  utility.   These
options are as follows:

    1. Diagnostic Error Messages
    2. Standard Disk Error Retry


16

The error indications made available to the User during disk error recovery are a function of the status of the Disk Subsystem Options in effect at the time of the anomaly. There are four possible option conditions and the indications for them are summarized below:

1. If "Diagnostic Error Messages" and "Standard Disk Error Retry" are both enabled then the disk error recovery is attempted five (5) times and if the operation fails all five times, the User is queried on line 25 to select the appropriate response from the following list of possibilities:

(R)etry/(A)bort/(C)ontinue/(I)gnore

2. If "Diagnostic Error Messages" is disabled and "Standard Disk Error Retry" is enabled the disk error recovery is attempted five (5) times and if the operation fails all five times the error is reported to BDOS without the line 25 query for appropriate action.

3. If "Diagnostic Error Messages" is enabled and "Standard Disk Error Retry" is disabled the disk recovery is attempted one (1) time and if unsuccessful the User is queried on line 25 for the appropriate action.

4. If "Diagnostic Error Messages" and "Standard Disk Error Retry" are both disabled the disk recovery is attempted one (1) time and if unsuccessful the error is reported to BDOS without the line 25 query.


3.5.1.4    ERRORS

Recoverable errors are reported to the user on line 25 according to the reporting options selected by the user during configuration option selection. Fatal errors are always reported both to the user and to BDOS. An explaination of the error messages is given in Appendix.


3.5.1.5    PERFORMANCE

Nominal.


3.5.1.6    OPERATIONAL CONSIDERATIONS

The system supports one standard QX-10 format and a number of additional formats on the RIGHT drive through the use of the SETUP utility which sets the disk format, density and double sided attributes. The two floppy disk drives are referred to as LEFT and RIGHT respectively by the SETUP and COPYDISK utilities.

17

On a system without hard disk support, the BIOS addresses the two diskette drives as "A" and "B". When hard disk support is available, disk designations can be altered at system generation time as well as cold boot time.

## 3.5.2    RAM DISK SUBSYSTEM

### 3.5.2.1    GENERAL DESCRIPTION

The customized BIOS supports one RAM disk occupying banks 2 and 3 of the QX-10 memory banks. The standard disk format for this implementation is 128 byte sectors with 128 sectors per track.

The system provides a locking mechanism to protect data in the RAM disk from being overlaid by data transferred via XBIOS Calls, to banks 2 and 3.

### 3.5.2.2    USER/OPERATOR INTERFACES

The RAM disk is configured as drive "M". This designation can be altered at system configuration time as well as by the drive assignment option of the SETUP utility. RAM disk support can be ENABLED or DISABLED through the SETUP utility.

There are three extended BIOS calls, XBIOS 48 - Move Block to another Bank, XBIOS 49 - Call Code in another Bank, and XBIOS 50 - Jump to Code in another Bank, that permit the user to move data and/or code to banks 2 and 3, and excute there. To execute one of these calls, the user must first execute XBIOS 46, Request Memory Bank, which insures that a contention for Banks 2 and 3 does not exist between the XBIOS calls and RAM disk usage.

Upon execution of XBIOS 46, the system checks the status of the RAM disk:

o    If the RAM disk status is DISABLED, the requested bank is allocated to the requesting code with a success condition returned.

o    If the RAM disk status is ENABLED, an error code is returned to the requesting code.

### 3.5.2.3    ERROR CONDITIONS

Two error conditions can occur:

- 1, RAM disk is ENABLED when XBIOS 46 is executed.

- 2, RAM disk is ENABLED and contains data, and user attempts to DISABLE RAM disk through SETUP.

If either condition occurs, the following message displays:

RAM disk data may be lost: (A)bort or (C)ontinue.

### 3.5.2.4   ABORTS AND RECOVERIES

If error condition 1:
-(A)bort warm boots with RAM disk still enabled.
-(C)ontinue disables RAM disk, allocates the requested bank.

If error condition 2:
-(A)bort leaves RAM disk ENABLED and warm boots.
-(C)ontinue DISABLES the RAM disk.

### 3.5.2.5   PERFORMANCE

Given  the nature of a RAM disk,  high speed data throughout
is generally achieved.

### 3.5.2.6   OPERATIONAL CONSIDERATIONS

Because  the  RAM  disk occupies a maximum  of  two  storage
banks, the capacity of drive "M" is limited.

The storage media is volatile.  Files can be corrupted  at
system  reset  and will be lost at  power  off.   Additional
overhead can accrue at cold boot if the given implementation
requires loading the RAM disk with files.

### 3.5.3      WINCHESTER DISK SUBSYSTEM

### 3.5.3.1   GENERAL DESCRIPTION

The BIOS supports one formatted,  ten-megabyte,  Comrex hard
disk.  When installed in the QX-10, the hard disk is divided
into  two  five-megabyte logical drives,  H1 and  H2.   Each
logical drive has 512-byte sectors and 16 sectors per track.

### 3.5.3.2   USER/OPERATOR INTERFACES

The   Comrex  hard  disk  is  accompanied  by  software  and
documentation that:

1.   Specifies hardware installation.
2.   Describes testing and maintenance procedures.

After  physically attaching the hardware to the  QX-10,  the
user  logically  installs the hard disk.   By selecting  the
Drive  Assignment Option of the SETUP utility the  user  can
assign  the two logical drives (H1 and H2) of the hard  disk
to any of the CP/M logical drives (A-P).

Note:  The system default drives are A::=F1 and B::=F2, where
F = floppy disk.


### 3.5.3.3    ABORTS AND RECOVERIES

Error reporting and error retry options are available to the
user  and  are  selectable from the  SETUP  utility.    These
options are as follows:

        1. Diagnostic Error Messages
        2. Standard Disk Error Retry

The error indications made available to the User during disk
error  recovery  are a function of the status  of  the  Disk
Subsystem  Options  in  effect at the time of  the  anomaly.
There   are   four   possible  option  conditions   and   the
indications for them are summarized below:

1.   If "Diagnostic  Error Messages" and "Standard Disk  Error
Retry"  are  both  enabled then the disk error  recovery  is
attempted five (5) times and if the operation fails all five
times,  the  User  is  queried  on line 25  to  select  the
appropriate   response   from   the   following   list   of
possibilities:

(R)etry/(A)bort/(C)ontinue/(I)gnore

2.   If "Diagnostic Error Messages" is disabled and "Standard
Disk  Error  Retry"  is enabled the disk error  recovery  is
attempted five (5) times and if the operation fails all five
times  the  error is reported to BDOS without  the  line  25
query for appropriate action.

3.   If  "Diagnostic Error Messages" is enabled and "Standard
Disk Error Retry" is disabled the disk recovery is attempted
one (1) time and if unsuccessful the User is queried on line
25 for the appropriate action.


4.   If "Diagnostic Error Messages" and "Standard Disk  Error
Retry"  are both disabled the disk recovery is attempted one
(1)  time and if unsuccessful the error is reported to  BDOS
without the line 25 query.


### 3.5.3.4    ERRORS

Recoverable  errors  are  reported to the user  on  line  25
according  to  the reporting options selected  by  the  user
during  configuration option selection.  Fatal  errors  are
always  reported  both  to  the  user  and  to  BDOS.   An
explanation of the error messages is given in Appendix B.

### 3.5.3.5   PERFORMANCE

The Comrex hard disk spins at 3600 rpm and transmits data at
5 million bits per second---approximately 10 times as fast as
a floppy disk.  The storage capacity of the Comrex hard disk
is 10 to 15 times greater than that of a floppy disk.


### 3.5.3.6   OPERATIONAL CONSIDERATIONS

Sudden  shocks  and  vibrations can damage  the  hard  disk.
Handle with care,  particularly when moving it from place to
place.


### 3.6        OPERATING SYSTEM CONFIGURATION


### 3.6.1      COLD BOOT LOADER


### 3.6.1.1    GENERAL DESCRIPTION

The  CP/M-80 R2.2 operating system is loaded into memory  in
two steps.   The QX-10 IPL ROM loads in the Cold Boot Loader
into  memory.   The  Cold Boot Loader loads the CP/M  Loader
which in turn loads CP/M-80.

The  IPL ROM brings in the first 4K of data from track 0  of
the diskette in the LEFT drive.   Included in this 4K is the
Boot  Loader  program.   The Boot Loader  program  relocates
itself down to location 100H (decimal 256) from the location
F000H.   The  loader  program  then loads  the  CP/M  Loader
program into memory.

The  CP/M Loader program is comprised of a condensed  loader
BDOS and a skeletal BIOS which provides disk I/O capablities
to  the loader.   The loader searches the directory for file
CPM2.SYS which is read into memory.   The file contains load
addresses and the entire CP/M structure.   The loader 'loads'
CP/M and jumps to the cold boot vector.

System configuration information,  as defined by the CP/M-80
configuration utility SETUP, is also contained in the system
track area. This information is not processed by the loaders.


### 3.6.1.2    USER/OPERATOR INTERFACES

When  the  system initiates the boot  sequence  the  "INSERT
DISKETTE"  message  is  erased from  the  screen.   The  next
message  to  be  displayed is the sign-on message  which  is

21

centered horizontally and displayed near the top of the
screen. The exact format of the sign-on message is given
below:

---

```
              CP/M-80 R2.2 FOR THE EPSON QX-10
           COPYRIGHT (C) 1983, EPSON AMERICA, INC.
                    ALL RIGHTS RESERVED
                  256K - VERSION B2.20
```

NOTE: The CP/M-80 A> prompt is shown for reasons of
completeness and is not part of the sign-on message itself.

3.6.1.3   ABORTS AND RECOVERIES

Standard disk error recovery is utilized as defined in
Appendix B.1.

3.6.1.4   ERRORS

If drive A is not ready, the boot ROM displays the message
"INSERT DISKETTE". If a non-system diskette is inserted into
drive A, the ROM will unsuccessfully attempt to read the
boot loader and continuously repeats the "INSERT DISKETTE"
message.

3.6.1.5   PERFORMANCE

Initial program load time takes approximately 17 seconds.

3.6.1.6   OPERATIONAL CONSIDERATIONS

The sign-on message and the CP/M-80 A> prompt are displayed
in normal intensity. At the completion of the Boot Loader
procedure the system is left in the normal intensity mode.

3.6.2   GENCPM - SYSTEM GENERATION

3.6.2.1   GENERAL DESCRIPTION

GENCPM2.COM is the system generation module for the B
Release of the Epson CP/M-80. Its purpose is to modify the
existing CPM2.SYS file, which contains the system BIOS,
BDOS, and the CCP.

To perform system generation, GENCPM2 requires the presence
of two files:

o   The CPM2.SYS file for the existing system

o   EBIOS.SPR, the System Page Relocatable file, which is
      created via selection of the B switch of the linker
      and contains the non-relocated BIOS Code.

3.6.2.2 USER/OPERATOR INTERFACES

OEM (User) decides which portion of the BIOS to assign to
common RAM (CSEG) and which portion to assign to banked RAM
(DSEG), and makes the appropriate assignments in source code
using the CSEG and DSEG assembler directives.

OEM (User) makes system modifications with an editor,
assembles the modified files with either RMAC (DRI) or M80
(Microsoft), links the modules with LINK80 (DRI) using the
linker B switch to create EBIOS.SPR, and finally runs
GENCPM2.COM. GENCPM2.COM relocates the DSEG and CSEG Code
segments and appends the relocated BIOS onto the CMP2.SYS file.

If there are no errors, the Memory Map (displaying the
locations of CSEG and DSEG) will be displayed. If there are
errors, error messages will be displayed.

3.6.2.3 ABORTS AND RECOVERIES

GENCPM2 aborts on any error condition. There are no
recovery techniques.

3.6.2.4 ERRORS

GENCPM2 checks for the presence of the CPM2.SYS and
EBIOS.SPR files. If either of these files is not present,
the appropriate message is displayed:

ERROR! EBIOS.SPR FILE NOT FOUND

ERROR! CPM2.SYS FILE NOT FOUND

If both CPM2.SYS and EBIOS.SPR are present, GENCPM2 takes
the header information from EBIOS.SPR and checks the size of
CSEG and DSEG.

If CSEG as coded in the EBIOS.SPR file exceeds the
boundaries allotted to it, the following message is displayed:

ERROR! CSEG TOO LARGE

If DSEG as coded in the EBIOS.SPR file exceeds the
boundaries allotted to it, the message is displayed:

Other possible error messages are CLOSE ERROR, which indicates that the CPM2.SYS file could not be closed, and READ/WRITE errors in accessing EBIOS.SPR or CPM2.SYS.

3.6.2.5 PERFORMANCE

The error-checking capabilities of GENCPM2 protect the user from unintentionally overlaying code.

3.6.2.6 OPERATIONAL CONSIDERATIONS

GENCPM2.COM updates the CPM2.SYS file present on the currently selected drive. The CPM2.SYS file would need to be copied to the bootable system diskette.

To make additional copies of the operating system, the user runs the "Copy System Only" option of the Epson COPYDISK utility, which copies both the system tracks and the CPM2.SYS file to the destination diskette.

3.6.3   OEM CONFIGURATION SUPPORT

3.6.3.1   GENERAL DESCRIPTION

OEM support is a major feature of the "B" release. The BIOS code is divided into logic modules (patterned after CP/M 3.0 structure) which are linked together to form the CP/M environment. OEM supplied modules which adhere to a defined structure can be included in the link process and become an integral part of the CP/M environment provided to the end user.

3.6.3.2   USER/OPERATOR INTERFACES

A dummy module named OEMINIT is provided for the use of the OEM to customize the system. This routine has two entry points: ?OEMIC and ?OEMIW. The entry point ?OEMIC is called by the cold boot logic, while ?OEMIW is called by the warm boot logic.

The OEM may add whatever logic is required to customize the operating system to his specific requirements. For example the OEM can add an interrupt routine to the system to handle a new device such as a hard disk drive. Another routine can be added which initializes another device at warm boot.

Below are outlined the guidelines which an OEM must follow to integrate customized routines to the QX-10 CP/M BIOS:

- All interrupt routines must be initialized in the ?OEMIC

24

routine.   The   start   of the interrupt vector table can   be
determined   by   references to the system   variable   @IPBASE.
The   ?OEMIC logic must set the interrupt routine address   in
the appropriate vector location in the table.

- Interrupts   must   not be enabled in either the   ?OEMIC   or
?OEMIW routines.

- The   interrupt   routine initialization logic must set   the
mask   value   for the appropriate 8259.   The OEM   must   know
which   8259 is responsible for handling the   interrupts   for
the   device   for which the routine is being   provided.   The
interrupt mask for the first 8259 can be found at @8259A and
the second at @8259B.   The initialization logic must access
the   value at that location and "OR" in the   necessary   mask
bit   for   that device.   Upon return from ?OEMIC the   system
will set the interrupt masks for each 8259.

- The interrupt routine must be in the same context (address
space)   as the system interrupt vector.   No   provision   has
been   made   for   the   system to perform   a   bank   switch   to
transfer control to an interrupt routine.

- An   OEM   interrupt routine is responsible for sending   the
EOI command to the appropriate 8259 after the interrupt   has
been   serviced.   The   routine   must   exit   with   the   RETI
instruction.

- If   at   anytime the OEM's logic wishes to change the   mask
bit   for   a device controlled by   the   OEM'S   routines,   the
appropriate   mask   byte may be accessed and changed   by   the
procedure   outlined   above.   The EOI routine may then   call
?825CA or ?825CB the have the mask value changed.

3.6.3.3   ABORTS AND RECOVERIES

The responsibility of the OEM.

3.6.3.4   ERRORS

The responsibility of the OEM.

3.6.3.5   PERFORMANCE

Not applicable.

3.6.3.6   OPERATION CONSIDERATIONS

- The initialization logic in ?OEMIC cannot program the 8259
controllers.   The   OEM must use the system values   for   the
8259 initialized by the BIOS.

- An OEM supplied interrupt routine is responsible for saving and restoring CPU status and all registers which are used by the routine.

3.7   SERIAL INTERFACE SUPPORT

3.7.1   GENERAL DESCRIPTION

The RS-232 serial port, of the QX-10 system is supported by the customized BIOS. The serial port is supported as character stream input/output devices and can be connected, by the User, to CP/M-80 R2.2 logical devices with the STAT utility. The System Configuration Utility is used to set the port characteristics and protocol to be supported by the BIOS routines. The ETX/ACK or XON/XOFF software handshaking protocols as well as the RTS/CTS hardware handshaking are supported by the BIOS routines.

3.7.2   USER/OPERATOR INTERFACES

The user interfaces with the serial port support through SETUP utility described in section 3.8. Port characteristics are defined through SETUP.

3.7.3   ABORTS AND RECOVERIES

None.

3.7.4   ERRORS

None.

3.7.5   PERFORMANCE

Nominal

3.7.6   OPERATIONAL CONSIDERATIONS

None

3.8   SETUP - SYSTEM CONFIGURATION UTILITY

3.8.1   GENERAL DESCRIPTION

The SETUP program allows the User to tailor the operating environment. The User can change the system configuration permanently or until the next cold start. The latter option allows a configuration to be tested before it is made

permanent.

The User interacts with SETUP through the SETUP menus.
Each menu has a self explanatory option list. For all SETUP
menus, line 24 is 'ENTER OPTION ==>'. Line 23 displays
SETUP informational and error messages to the User.

SETUP is a stand alone-utility program comprised of several
modules written in Pascal and Z80 assembler.

3.8.2 USER/OPERATOR INTERFACES

The Main Option List allows the user to pick which part of
the system configuration to examine and/or change. Exit
from SETUP is accomplished by selecting the exit type from
the Exit Option List.

The Main Option List screen is displayed on the following
page.

```
                    SETUP - Version 2.20
                 System Configuration Utility
                CP/M-80 R2.2 for the Epson QX-10
              COPYRIGHT c 1983 Epson America, Inc.


                       MAIN OPTION LIST:


    A - Display Options              F - Drive Assignments
    B - Date and Time Options        G - Serial Port Options
    C - Keyboard Options             H - Printer Support Options
    D - Function Key Modification    I - Auto Boot Execution Options
    E - Disk Subsystem Options



                       EXIT OPTION LIST:

         P - EXIT and Permanently Update Configuration
         T - EXIT and Test Updated Configuration
         Q - Abort SETUP with no Configuration Changes


         ENTER OPTION ==>
```

Main Menu

Main menu options A through I cause SETUP to display
additional menus which display current values in effect and
allows alteration of the configuration. The user then
initiates changes to these values by selecting the
appropriate option. The configuration values displayed are
for the system that is currently running.

27

Exit from SETUP is always accomplished from the main menu.
The 'P' option, to exit and permanently update the
configuration, changes the configuration of the running
system and records the configuration information on disk.
The 'T' option, to exit and test the updated configuration,
changes only the running system (in memory). These values
will remain in effect until SETUP is run again or until a
cold boot. When the user is satisfied with the values the
'P' option will make the configuration permanent. The 'Q'
option, to abort SETUP results in no changes to the running
system or permanent disk configuration. It should be noted
that after the selection of keyboard, merely exiting to the
Main Menu via the 'P' or 'T' option does not cause the
selected keyboard option to take effect. Either a cold boot
or a system reset is required to effect this change.

The current CP/M-80 R2.2 IOBYTE is also saved when the
configuration is made permanent on disk. Although there is
no menu for changing the IOBYTE, it can be interogated and
altered by the STAT command and saved with the SETUP
utility.

The second level menus are specific to each functional area
of the system configuration; Display, Disk Subsystem,
Keyboard, Serial Port and Printer options. Each menu has a
full screen display and is self-prompting.

3.8.2.1   Display Options

          STATUS   DISPLAY OPTION:

          ENABLED   1 - Auto Line Wrap

          ENABLED   2 - Blinking Cursor

          DISABLED   3 - Bit 7 Masking

                               E - Exit to MAIN MENU

                    ENTER OPTION ==>

Display Option Menu

NOTE: For the above menu, and all subsequent option menus,

the values shown under the 'STATUS' column are the installed defaults.

When auto line wrap is enabled, the characters input are displayed on the next line if there is line overflow; a carriage return and a line feed are automatically issued when the end of a line is encountered. When auto line wrap is disabled, a line overflow results in subsequent characters being displayed in the last character position. Previous overflow characters are overwritten. In both modes, no information is lost.

When the blinking cursor is enabled the cursor will appear as a blinking block rather than a steady block.

Bit 7 Masking is selected when the User wishes to mask off the most signifigant bit (MSB) of the ASCII character set in order to use older versions of software on this system which require seven bit ASCII character codes.

3.8.2.2   Date and Time Option:

```
            STATUS                    DATE AND TIME OPTION

            ENABLED              1)   Date and Time Display

                                 2)   Date and Time Setting



                                 E - Exit to MAIN MENU


                      ENTER OPTION ==>
```

Time of Day Option Menu

When the Date and Time Display option is enabled, the current date and time values are displayed on line 25 in the lower righthand section of the screen.

When the Date and Time Setting option is selected, the following prompt is displayed at the bottom of the screen and the user is requested to enter the proper information.

                Enter DATE & TIME: DAY MM/DD/YY   HH:MM

At this time, the User inputs the requested data in the

given format, basing time on a 24-hour clock, and depresses
the return key. After the information has been successfully
processed, the User is returned to the option screen.

If the information is not input correctly the User gets one
of the following error messages, depending upon the nature of
the input error.

   a. For an incorrect Day format input:

      *** ERROR: Invalid Day of Week ***

   b. For an incorrect date format input:

      *** ERROR: Invalid Date Format ***

   c. For an incorrect hour format input:

      *** ERROR: Invalid Hour ***

   d. For an incorrect minute format input:

      *** ERROR: Invalid Minute ***

In all cases to correct the error condition, the User merely
inputs the correct data and depresses return for a
successful operation.

3.8.2.3   Keyboard Options

The keyboard option menu allows the User to enable or
disable typamatic keys and the type of keyboard which is
connected to the QX-10 system.

   STATUS   KEYBOARD OPTIONS:

   ENABLED   1)   Typamatic Keys

    HASCI   2)   Select Function Key Mapping

   CAPS LOCK   3)   SHIFT LOCK Key Interpretation

                    E - Exit to MAIN MENU

                    ENTER OPTION ==>

Keyboard Subsystem Menu

30

The selection of option 1 allows the User to disable the typamatic feature (keys repeat when held down) of the keyboard.

Option 2 allows the user to request that one of three function key definitions be installed. The definitions are 1) the default QX-10 function key mappings assigned by either Epson or an OEM, 2) the default TVI-920 mapping which assigns function keys F01-F10 unshifted and shifted, and 3) a user definable set of function keys. The options are QX-10, TVI-920 or Custom.

Option 3 determines the interpretation of the SHIFT LOCK key. Key processing can be set emulate 1) SHIFT LOCK as on a typewriter, 2) CAPS LOCK as on a terminal.

3.8.2.4. Programmable Function Key Assignment

The Function Keys Assigment menu allow the user to modify the text string stored for each function key.

```
        STATUS              FUNCTION KEY OPTION:


         STOP               1) Select Function Key

        ENABLED             2) Enable Function Keys

        DISABLED            3) Carriage Return Delimiter

                            4) Function Key String

                            E - Exit to MAIN MENU



                            ENTER OPTION ==>
```

Option 1 allows the user to select the function key to be viewed and/or modified. Function keys are selected by pressing the particular function key that is to be viewed and/or modified.

Option 2 allows the user to either ENABLE or DISABLE a specified function key.

Option 3 designates whether a carriage return is to be appended to the end of the string.

31

Option 4 allows the operator to change the actual string
text. The string may be from 0 to 24 characters long. Any
valid binary character which can be input from the keyboard
can be entered. The hex values 01H-1FH can be generated by
control sequences A-Z,[,\,],^,_. The values in this range
do not have printable characters and will be denoted by
displaying the '^' character above the control character
required to generate the sequence. For example, the TVI-920
function key 1 generates hex values 01H,40H,0DH. The 01H is
generated by a control 'A', the 40H is the character '@' and
the 0DH is a carriage return which is accounted for with
option 2 described above. The sequence 01H,40H is displayed
as follows:

```
    ^
   A@
```

3.8.2.5   Disk Subsystem Options

The disk subsystem menu allows the User to specify
attributes of the disk subsystem.

```
    STATUS              DISK SUBSYSTEM OPTIONS:


    ENABLED         1)  Diagnostic Error Messages

    ENABLED         2)  Standard Disk Error Retry

    ENABLED         3)  RAM Disk

    QX-10           4)  Format of Right Diskette

                    E - Exit to MAIN MENU



                    ENTER OPTION ==>
```

Disk Subsystem Menu

When option 1 is enabled, diagnostic error messages are
reported to the User when an error, hard or soft, occurs in
the disk subsystem. Non-recoverable errors are always
reported to the user regardless of the setting of option 1.

Disk error recovery is always attempted. The number of disk
recovery attempts and the indications presented to the User

32

to help resolve the situation are a function of the settings for option 1 and option 2 given above. Section x.x.x on page xx of this document summarizes the four possible error reporting conditions, retry attempts and messages.

Neither options 1 nor 2 affect the display of the disk error messages described in Appendix B.2.

Option 3 either enables or disables the RAM disk. Disabling the RAM disk makes banks 2 and 3 available as extended TPA address area through the use of extended BIOS calls TUNNEL and TRESPASS.

Option 4 allows the user to change the diskette format of the RIGHT disk drive. Upon selecting Option 4, the user is presented with a display showing all the currently supported optional formats. Refer to Appendix D for a list of optional formats supported.

3.8.2.6   Drive Assignment Option

The Drive Assignment option allows the user to reassign the logical disk drive designations of the diskette drives and hard disk drive subsystems.

DRIVE ASSIGNMENTS AS CURRENTLY DEFINED:

A:	B:	C:	D:	E:	F:	G:	H:
L-F	R-F						

I:	J:	K:	L:	M:	N:	O:	P:
				RAM			

A:	B:	C:	D:	E:	F:	G:	H:
L-F	R-F						

I:	J:	K:	L:	M:	N:	O:	P:
				RAM			

```
        --> - Move Right
        <-- - Move Left
        E  - Exit to Main Menu
```

The upper portion of the screen shows the current physical to logical disk assigments. The valid range of logical drives is A: through P:. The physical drives are prefixed with an 'H' for hard drives, 'F' for floppies and 'M' for memory or ramdisk. The lower portion of the screen allows the user to change the assignments by selecting a physical

device and the logical device it is assigned to.

3.8.2.8   Serial Port Options

The Serial Port menu allows the User to specify the attributes of the serial port.

   STATUS   SERIAL PORT OPTION:

   1200   1 - Baud rate

   NONE   2 - Line Protocol

   NONE   3 - Parity

    8   4 - Data Length in Bits

    1   5 - Number of Stop Bits

 DISABLED   6 - Bit 7 Masking

 DISABLED   7 - Interrupt Driver

                 E - Exit to MAIN MENU

                 ENTER OPTION ==>

Serial Port Option Menu

Option 1:   Allows the User to select the desired Baud rate for the port. There are 15 Baud rates available from None to 9600.

Option 2:   Allows the User to select ETX/ACK, XON/XOFF or no protocol for software handshaking or the hardware handshaking protocol CTS/RTS may be selected.

Option 3:   Allows the User to select either odd, even or no parity.

Option 4:   Allows the User to set either 5, 6, 7 or 8 as the data length.

Option 5:   Allows the User to set the number of stop bits to 1, 1.5 or 2.

Option 6:   Allows the User to Mask off the most significant bit (MSB) of the ASCII character set.

Option 7: Allows the User to enable or disable an interrupt driver for handling serial port input.

3.8.2.9   Printer Support Options

The Printer Support options allows the user to identify the type of printer attached to the parallel port inorder to allow the BIOS provide proper status byte interpretation.

STATUS	PRINTER SUPPORT OPTION
FX-80	1) Attached Printer
DISABLED	2) Bit 7 Masking
DISABLED	3) Single Sheet Mode
	E - Exit to MAIN MENU

Option 1: Allows the user to specify the status byte support required at the paralled port.   Options are the various printers in the Epson printer product line,   standard Centronics interface or None.   If a printer is attached to the serial port (instead of the parallel port) option None should be entered.

Option 2:   Allows the User to mask off the most sigmificant bit (MSB) of the data being sent to the printer.

Option 3:   The User can select single sheet mode to redirect the bios to handle error processing accordingly.   It should be noted that proper single sheet processing requires that paper-out detect be disabled on the attached printer.

3.8.2.10 Auto Boot Execution Option

The Auto Boot Execution option menu allows the User to enable a command to be automatically executed on cold boot.

STATUS	AUTO BOOT OPTION:
DISABLED	1) Execute Auto Boot Command on Cold Start

```
        DIR            2)  Command to be Executed


                 E - Exit to MAIN MENU



                 ENTER OPTION ==>
```

Auto Boot Execution Menu

Option 1 allows the User to specify that a user defined
command is to be automatically executed on a cold start.

Option 2 allows the user to define the command string.   The
string can be from 0 to 24 characters long.

3.8.3   ABORTS AND RECOVERIES

Nominal

3.8.4   ERRORS

Errors are reported to the user.

3.8.5   PERFORMANCE

Nominal

3.8.6   OPERATIONAL CONSIDERATIONS

For the Main Menu, the heading MAIN OPTION LIST: AND EXIT
OPTION LIST: are displayed in normal intensity.   The
remainder of the menu is displayed in half intensity. When
any second level menu is selected the Main Menu is cleared
from the screen.

For the second level menues the header STATUS, the options
title (e.g. DISPLAY OPTION:) and the ENTER OPTION ==> are
displayed in normal intensity. The actual status values in
each menu are displayed in half intensity.

For all second level menues except the Serial Port option
menu, the choices the User has for each option are displayed
on line 23 in reverse video.   In the case of the Serial Port
options the choices are displayed in as many lines as

                             36

required with the last line always being line 23. These
choices are also displayed in reverse video.

The third level displays do not cause the second level
menues to be cleared from the screen. Selection of available
choices by the User is always accomplished by single number
or letter keystrokes. In the case of ENABLE or DISABLE, "0"
is always the DISABLED selection and "1" is always the
ENABLED selection.

3.9   COPYDISK - DISKETTE FORMAT AND COPY UTILITY

3.9.1   GENERAL DESCRIPTION

The COPYDISK program allows the User to format and copy
diskettes. The User interacts with COPYDISK through the
COPYDISK menus.

COPYDISK is a stand-alone program written in PASCAL MT+.

3.9.2   USER/OPERATOR INTERFACES

The menu system consists of two levels. Each menu has a
self-prompting option list. For all COPYDISK menus, line 24
is 'ENTER OPTION ==>'. Line 23 displays both COPYDISK
informational and error messages. The main menu allows the
User to select a format operation or a copy operation. A
copy operation formats the destination diskette prior to the
copy operation when the User selects the COPY ALL option.
To exit from COPYDISK, see the main menu.

```
            C O P Y D I S K - Version 2.20
               Diskette Format/Copy Utility
            CP/M-80 R2.2 for the Epson QX-10
         COPYRIGHT c 1983 Epson America, Inc.


                    MAIN OPTION LIST:

        1 - Format and Erase a Diskette

        2 - Copy the Contents of One Diskette to Another

        3 - Create an Application Program Diskette

        E - Exit to CP/M




                    ENTER OPTION ==>
```

Main Menu

Main menu options cause COPYDISK to present menus that
display Format and Copy options. The E option, from the main
menu, is used to exit from COPYDISK to CP/M.

Format Options

The format option menu allows the User to specify a format
option for formating a diskette.

```
    STATUS              FORMAT OPTION LIST

    RIGHT           1 - Location of Diskette to be
                        Formatted


                    FORMAT COMMAND LIST

                    S - Start FORMAT Operation

                    E - EXIT to Main Menu




                    ENTER OPTION ==>
```

Format Option Menu

Option 1 selects either the RIGHT or LEFT drive for the
format operation. The Format procedure erases all files on
the destination diskette. The selection of the S option will
start the operation when the User is satisfied with the disk
assignment. The E option exits the User back to the main
options menu.

Disk Copy Options

The Copy Options menu allows the User to specify options for
the copying of one diskette to another.

```
STATUS              COPY OPTIONS LIST:

LEFT                    Location of Diskette to be copied FROM

RIGHT                   Location of Diskette to be copied TO

ALL              1 - Copy All, System or Data Tracks


                    COPY COMMAND LIST

                 S - START COPY OPERATION

                 E - EXIT TO MAIN MENU


                 ENTER OPTION ==>
```

Copy Options Menu

If the User selects a complete copy operation (the "ALL" alternative of option 1), then the utility formats the destination disk (destroying all previous files) with the same format as the source diskette. After completion of the format, the utility will read tracks from the source diskette, and then writes them to the destination diskette. This process continues until the entire source diskette is read and copied. As tracks are written to the destination diskette they are verified.

The "SYSTEM" or the "DATA TRACKS" alternative of option 3 allows the system only (system tracks and CPM2.SYS file) or the data tracks only of the source drive to be copied to the destination diskette. In both of these cases the diskette is not pre-formatted.

3.9.3   ABORTS AND RECOVERIES

Nominal

3.9.4   ERRORS

Errors are reported to the User.

3.9.5   PERFORMANCE

Nominal

3.9.6   OPERATIONAL CONSIDERATIONS

A single disk system copy procedure requires at least 10 operator steps to perform a disk format and copy operation.

For the main menu, MAIN OPTION LIST: is displayed in normal intensity. The remainder of the menu is displayed in half intensity. When secondary menus are selected the Main Menu is cleared from the screen.

For the Format Option menu and the Copy Option menu, STATUS, FORMAT OPTION LIST:, FORMAT COMMAND LIST:, COPY OPTIONS LIST:, COPY COMMAND LIST: and ENTER OPTION ==> are displayed in full intensity. The actual status items are displayed in reverse video. The remainder of the display is half intensity. The choices for each option are displayed in line 23 in reverse video and the secondary menus are not cleared. Selection of available choices by the User is accomplished by single keystrokes.

3.10   MEMORY MAP

3.10.1   GENERAL DESCRIPTION

The memory map for this implementation of CP/M-80 is defined as follows:

```
FFFFH   ---------------------------------------------------------------
        :            :            :                            : \
        : RESIDENT:              :                            : \
        :  BIOS   :              :                            :  \
        :            :            :                            :   \
        :------------:            :                            :    \ COMMON
        :  BDOS    :              :                            :    / RAM
        :            :            :                            :   /
E200H   :------------:------------:                            :  /
        ://////////:  CCP       :                            : /
E000H   :------------:            :--------------------------: /
        :            :------------:                          :
        : BANKED   :            :                          :
        :  BIOS    :  TPA       :                          :
        :            :            :                          :
        :            :            :                          :
        :            :            :   RAM DISK M            :
        :            :            :                          :
        :            :            :      OR                 :
        :            :            :                          :  BANKED RAM
        :            :            :   EXTENDED TPA          :
        :            :            :   ADDRESS SPACE         :
        :            :            :                          :
1600H   :------------:            :                          :
        :            :            :                          :
        :  CCP/    :            :                          :
```

40

```
|   BDOS   |---------------|---------------|---------------|  0100H
|         |   PAGE 0  |   PAGE 0  |   PAGE 0  |
0000H   |_____|_____|_____|_____|
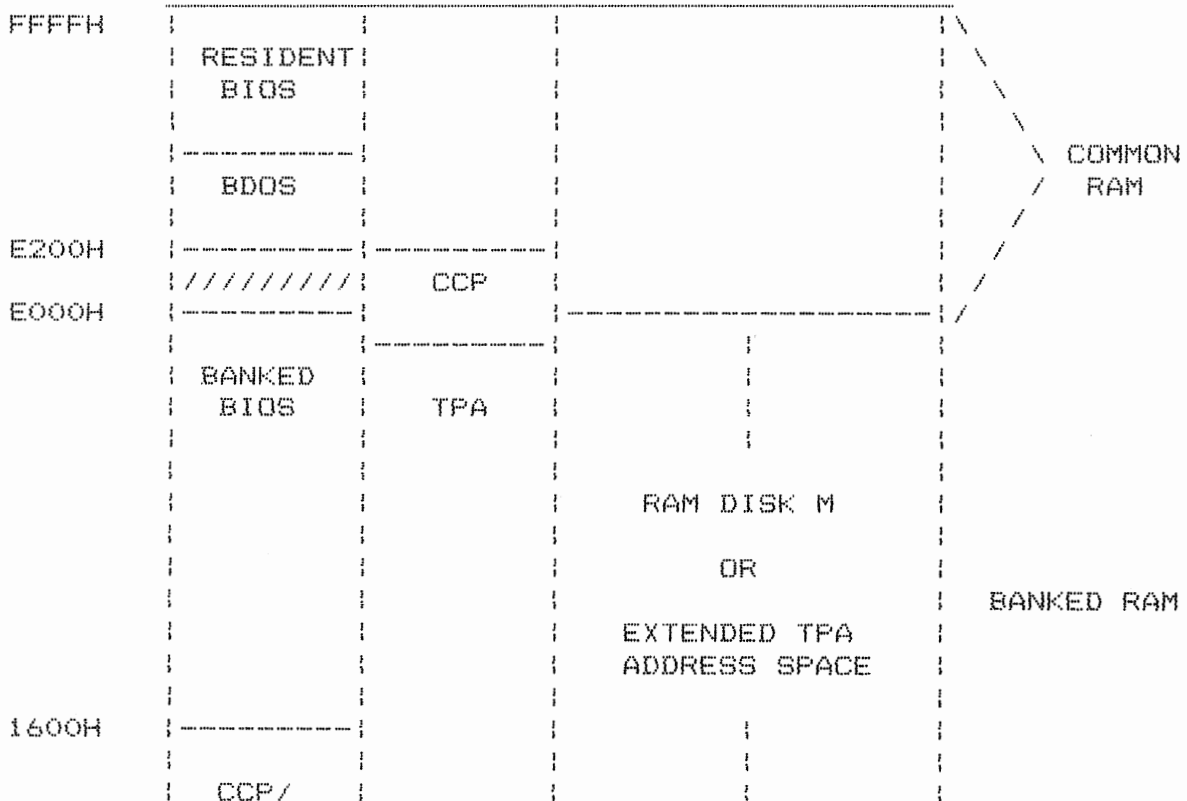
     BANK 0      BANK 1      BANK 2      BANK 3
```

Table 1-5   Memory Map

MODULE	BASE ADDRESS
BIOS	F000H
BDOS	E200H
CCP	DA00H

Table 1-6   Operating System Base Addresses

The memory map in Table 1-5 indicates full utilization of
256K RAM.   Bank 0 is reserved as the system bank.   The BIOS
is divided into two distinct sections.   The resident section
resides in common RAM and is responsible for intercepting
BIOS calls, swapping in the system bank, and vectoring to
the appropriate code in the banked BIOS.   By segmenting the
BIOS as shown, code overhead is reduced to a minimum
enabling the TPA to increase to an acceptable size.   The TPA
extends into common RAM.   The shaded area indicates the
portion of common RAM overlayed by the TPA.   If the
application program residing in the TPA does not make any
BDOS calls, the TPA can also overlay BDOS.   Table 1-6 shows
typical base addressess of the main components depending on
hard disk options.

The RAM disk is mapped onto banks 2 and 3.   The RAM disk is
activated/deactivated through a SETUP selection.   When the
RAM disk is disabled, an intelligent program using XBIOS
calls 48, 49 and 50 can use banks 2 and 3 as additional data
and code sections.

3.11   BIOS INTERFACE

Table 1-7 below describes the entry points into the BIOS.
The first 16 entry points correspond to the standard CP/M-80
implementation.   Entries 17-29 are null entries which
produce a return to the invoking code.   The last entry
point, OXFUNC, is an Epson unique entry point through which
the extended BIOS services are provided.   OXFUNC is the 30th
vector which in CP/M Plus is reserved for System
Implementor.   This provides a common entry point in both
CP/M-80 and CP/M Plus.

41

No.	Entry Name	Function
1	BOOT	Cold Boot Entry
2	WBOOT	Warm Boot Entry
3	CONST	Console Input Status
4	CONIN	Console Input
5	CONOUT	Console Output
6	LIST	List Output
7	PUNCH	Punch Output
8	READER	Reader Input
9	HOME	Home Selected Disk
10	SELDSK	Select Disk
11	SETTRK	Set Track Number
12	SETSEC	Set Sector Number
13	SETDMA	Set DMA Address
14	READ	Read Sector
15	WRITE	Write Sector
16	LISTST	List Device Status
...		Null Entries
30	QXFUNC	QX-10 XBIOS Functions

Table 1-7   BIOS Entry Points

The QX-10 XBIOS Functions are described on the following page.

The CP/M convention for accessing BDOS functions is adopted for accessing the XBIOS Functions.   The XBIOS Functions are accessed by making a direct call to QXFUNC.   The function number is passed in register C with the information address in the double byte pair DE.   The XBIOS calls adhere to normal CP/M conventions concerning BIOS responsibilities in register maintenance.   The following

- The XBIOS routines do not maintain registers.   The results of registers upon return is is guaranteed only for registers returning result codes or specified data.

- The XBIOS routines use the alternate register set. An application using the alternater register set must save registers prior to making an XBIOS call.

- The XBIOS routines use the IX and IY registers.   The application program must preserve the IX and IY registers prior to making an XBIOS call.

XBIOS 00   Floppy Disk Drive Function
XBIOS 01   Flush Active Floppy Disk Buffer
XBIOS 02   Disk Error Reporting

42

```
XBIOS 03          Get DRVTBL Address
XBIOS 04          Set Foreign Disk Format
XBIOS 05          Get System Data Page
XBIOS 06          Update System Data Page
XBIOS 07          Put System Data Page
XBIOS 08          Get Time
XBIOS 09          Put Time
XBIOS 10          Reserved
XBIOS 11          Reserved
XBIOS 12          Reserved

XBIOS 13          Load Font
XBIOS 14          Select Font
XBIOS 15          Read Custom Font
XBIOS 16          Write Custom Font
XBIOS 17          Save Current Font Number
XBIOS 18          Restore Current Font Number
XBIOS 19          Reserved

XBIOS 20          Get Scan Code Table
XBIOS 21          Put Scan Code Table
XBIOS 22          Save Scan Code Table
XBIOS 23          Restore Scan Code Table
XBIOS 24          Get Scan Character
XBIOS 25          Put Scan Character
XBIOS 26          Read Scan Code Table
XBIOS 27          Write Scan Code Table
XBIOS 28          Reserved
XBIOS 29          Reserved

XBIOS 30          Select Function Key Table
XBIOS 31          Save Current Function Key Table Pointer
XBIOS 32          Restore Function Key Table Pointer
XBIOS 33          Get Selected Function Key Table
XBIOS 34          Put Selected Function Key Table
XBIOS 35          Save Selected Function Key Table
XBIOS 36          Restore Selected Function Key Table
XBIOS 37          Get Function Key
XBIOS 38          Put Function Key
XBIOS 39          Disable System Key
XBIOS 40          Enable System Key
XBIOS 41          Read Custom Function Key Table
XBIOS 42          Write Custom Function Key Table
XBIOS 43          Enable Keyboard Reset at Warm Boot
XBIOS 44          Perform Warm Boot Reset
XBIOS 45          Reserved

XBIOS 46          Request Memory Bank
XBIOS 47          Release Memory Bank
XBIOS 48          Move Block to another Bank
XBIOS 49          Call Code in another Bank
XBIOS 50          Jump to Code in another Bank
XBIOS 51          Display RAM Disk Overwrite Message
XBIOS 52          Reserved
XBIOS 53          Reserved
```

```
XBIOS 54          PSET - Pixel Set/Reset
XBIOS 55          Set Viewport
XBIOS 56          Reserved
XBIOS 57          Reserved
XBIOS 58          Reserved
XBIOS 59          Reserved

XBIOS 60          Set User Interrupt Vector
XBIOS 61          Clear User Interrupt Vector
XBIOS 62          Get Interrupt Mask
XBIOS 63          Enable Interrupt
XBIOS 64          Disable Interrupt
XBIOS 65          Get User Common Address
XBIOS 66          Attach MTERM Interrupt Code
XBIOS 67          Detach MTERM Interrupt Code
XBIOS 68          Reserved
XBIOS 69          Reserved

XBIOS 70
  ...             Reserved
XBIOS 239

XBIOS 240
  ...             Reserved for VAR implementation
XBIOS 255


XBIOS 00          Floppy Disk Drive Function

Entry:    A  = Error Reporting Control
               0 - BIOS reports error
               1 - Error Returned to Calling Code


          C  = 00
          DE = Parameter Buffer Address

Buffer Contents:      byte 0 - Unit number 0,1
                               0: Left Drive
                               1: Right Drive

                      byte 1 - Function code
                               0: Home
                               1: Read data track
                               2: Write data track
                               3: Read system track
                               4: Write system track

                      byte 2 - Sector
                               0-31: system track
                               0-19: data track

                      byte 3 - Track
                               0-39

                      byte 4,5 - DMA Address (Intel format)
```

44

```
                              DMA buffer size
                              256 bytes: system track
                              512 bytes: data track

Return:    A =  0 - operation successful
           A <> 0 - operation unsuccessful
                3 - read/write error
                4 - seek error
                5 - disk not ready error


XBIOS 01          Flush Active Floppy Disk Buffer

Description:
           This  XBIOS call will write a 'dirty' disk  buffer
           onto the affected diskette.

Entry:     C = 01

Return:    A =  0 - operation successful
           A <> 0 - operation unsuccessful

XBIOS 02          Disk Error Reporting

Description:
           This XBIOS call displays disk error message on the
           25th line and waits for user  response.   Although
           it  prompts user to enter (R) for retry,  (A)  for
           abort,  (C)  for continue and (I) for ignore,  the
           program does not limit the entry to these 4  char-
           acters.  If "A" is entered, the system will select
           drive  A then do a warmboot.   All other character
           will  be  converted to upper case (ANI  0DFH)  and
           returned in register A.   It is the responsibility
           of the application program to take care of  retry,
           continue,  ignore  or  other  operations  after
           receiving the character from user.

Entry:     C = 02
           A = Error Code
                3 - read/write error
                4 - seek error
                5 - drive not ready
           B = Error Drive Designator (0-15)

Return:    A = Action Code
                "R" - Retry
                "C" - Continue
                "I" - Ignore
                Other characters entered by user
           A = -1 indicates error in input parameters


XBIOS 03          Get DRVTBL Address
```

Description:

      Drvtbl defines the physical to logical disk drive
      assignment. Sixteen entries are available for
      logical drive A to P. For existing physical
      drive, the address of its disk parameter table is
      put in the proper entry corresponding to the
      logical drive letter. Entries for non-existing
      drives are set to zero.

Entry: C = 03

Return: DE = Address of DRVTBL in common RAM

XBIOS 04   Set Foreign Disk Format

Entry: C = 04
         DE = Pointer to DPB and NEC 765 parameter table.

         Following are tables for QX-10 380K format.

```
@DT5B:    DW     80           ;SECTORS PER TRACK
          DB     4            ;BSH
          DB     15           ;BLM
          DB     1            ;EXM
          DW     190-1        ;BLOCKS-1
          DW     128-1        ;TOTAL DIR ENTRIES
          DW     192          ;DIR BLOCK ALLOCATION
          DW     32           ;CHECKED DIR ENTRIES
          DW     2            ;DIRECTORY TRACK

@PTBLB:
          DB     16           ;BLKSIZE/128
          DB     80           ;HSTBLK * HSTSPT
          DB     2            ;SECTOR SHIFT FACTOR
          DB     3            ;SECTOR MASK
          DB     10           ;# SECTORS/TRK
          DB     15           ;DISK GAP FACTOR
          DB     2            ;NEC 765 SECTOR FACTOR
          DW     512-1        ;DMA BYTE CNT FACTOR
          DB     4            ;SECTOR TRANSLATE FACTOR
          DB     0            ;LONG DISK FLAG
          DB     40           ;DISKETTE TRACK COUNT
```

XBIOS 05   Get System Data Page

Description:

      Get a copy of current system data page in memory
      into a 128 byte buffer pointer by register DE.

Entry: C = 05
         DE = Address of 128 byte buffer

Return: Contents of SDP moved to buffer

XBIOS 06   Update System Data Page

Description:
          Put the content of the 128 byte buffer pointed by
          register DE into current system data page in memory.

Entry: C = 06
          DE = Address of 128 byte buffer

Return: Contents of buffer moved to SDP

XBIOS 07   Put System Data Page

Description:
          Copy the content of current system data page in memory
          into diskette.   The bootable diskette must be in the
          left drive.   System data page is located at physical
          track 0, sector 2 of the diskette.   The description of
          each byte in the system data page can be found at
          appendix G.

Entry: C = 07

Return: A = 0 -- operation successful
          A <> 0 -- operation unsuccessful

XBIOS 08   Get Time

Entry: C = 08
          DE = Address of a 7 byte buffer

Buffer contents: byte 0 -- day of week (1--7)
                         byte 1 -- month (1-12)
                         byte 2 -- day (1-31)
                         byte 3 -- year (0-99)
                         byte 4 -- hour (0-23)
                         byte 5 -- minute (0-59)
                         byte 6 -- second (0-59)

Return: Date and Time information moved to buffer

XBIOS 09   Put Time

Entry: C = 09
          DE = Address of a 7 byte buffer

Buffer contents: same as XBIOS 08

Return: Date and Time information moved from buffer
          and clock chip initialized.

XBIOS 10   RESERVED

47

Entry: C = OAH

Description: Reserved for future expansion.   No operation.

XBIOS 11   RESERVED

Entry: C = OBH

Description: Reserved for future expansion.   No operation.

XBIOS 12   RESERVED

Entry: C = OCH

Description: Reserved for future expansion.   No operation.

XBIOS 13   Load Font

Description:

    This XBIOS call is used to load a user defined
    font into STYLE font area.   Each individual
    character   requires 16 bytes of   data.   The
    following example shows how to build a character
    out of the 16 byte bit image.

    The 16 byte data for standard font "B" is

    41h,41h,21h,1fh,0,0,0,0,1fh,21h,41h,41h,21h,1fh,21h,41h

                      bit   0 1 2 3 4 5 6 7
        byte   data
          8   1f   x x x x x
          9   21   x   x
         10   41   x   x
         11   41   x   x
         12   21   x   x
         13   1f   x x x x x
         14   21   x   x
         15   41   x   x
          0   41   x   x
          1   41   x   x
          2   21   x   x
          3   1f   x x x x x
          4   0
          5   0
          6   0
          7   0

    The buffer size for the STYLE font is OCOOH.   The
    first O600H is designated to the STYLE font and
    the remaining O600H to the STYLE BOLD font.   The
    fonts   are numbered from OOH to 5FH   which

48

corresponds to ASCII code 20H to 7FH.   Refer to
                    appendix H for fonts tables.

Entry: C = 0DH
            DE = Address of buffer area containing font

Return: Font moved to STYLE font area

XBIOS   14   Select Font

Entry: C = 0EH
            A = Font # to be selected
                    0: standard
                    1: standard bold
                    2: italic
                    3: italic bold
                    4: style
                    5: style bold
              others: return with no font changed

Return: Font pointer updated to point to selected font

XBIOS 15   Read Custom Font

Description: Read STYLE fonts from system track into memory.

Entry: C = 0FH

Return: A = 0 - operation successful
            A <> 0 - operation unsuccessful

XBIOS 16   Write Custom Font

Description: Write STYLE fonts from memory to system track.

Entry: C = 10H

Return: A = 0 - operation successful
            A <> 0 - operation unsuccessful

XBIOS 17   Save Current Font Number

Entry: C = 11H

Return: The current font pointer is saved.

XBIOS 18   Restore Font Number

Entry: C = 12H

Return: The font pointer is restored.

49

XBIOS 19   RESERVED

Entry: C = 13H

Description: Reserved for future expansion. No operation.

XBIOS calls 20-29 deal with the keyboard scan code table.
The size of the scan code table is 0300H bytes.   The tables
contain the maps to translate keyboard scan codes to 8-bit
data bytes which are input into the BIOS console input
buffer.   System keys and Function keys are handled in other
tables.   The structure of the 0300H table is shown as follows:

```
 00h    ┌──────────────────────────────────┐
        │                                  │
        │          no shift keys           │
        │                                  │
 80h    ├──────────────────────────────────┤
        │                                  │
        │             shift                │
        │                                  │
100h    ├──────────────────────────────────┤
        │                                  │
        │            control               │
        │                                  │
180h    ├──────────────────────────────────┤
        │                                  │
        │          control shift           │
        │                                  │
200h    ├──────────────────────────────────┤
        │                                  │
        │           graph shift            │
        │                                  │
280h    ├──────────────────────────────────┤
        │                                  │
        │        graph shift shift         │
        │                                  │
300h    └──────────────────────────────────┘
```

Refer to Appendix A for scan code tables.

XBIOS 20   Get Scan Code Table

Entry: C = 14H
           DE = Address of 1K buffer

Return: Keyboard Scan Code Table moved to buffer

XBIOS 21   Put Scan Code Table

Entry: C = 15H
           DE = Address of 1K buffer containing user-defined
                scan code table.

Return: User scan codes moved over system scan code table

XBIOS 22   Save Scan Code Table

Entry: C = 16H

Return: Contents of System Scan Code Table copied to save area

XBIOS 23   Restore Scan Code Table

Entry: C = 17H

Return: Contents of scan code save area copied over System Scan
           Code (only if a XBIOS 22 function previously performed)

XBIOS 24   Get Scan Character

Entry: C = 18H
           D = Shift Mask
                000B : no shift keys
                001B : shift
                010B : control
                011B : control shift
                100B : graph shift
                101B : graph shift shift
           E = Scan Code
                0 - 7FH

Return: A = Assigned Code

Example: If   D = 0 , E = 43h
           Then   A = 61h
           See appendix A.2

XBIOS 25   Put Scan Character

Entry: C = 19H
           D = Shift Mask
                000B : no shift keys
                001B : shift
                010B : control
                011B : control shift
                100B : graph shift
                101B : graph shift shift
           E = Scan Code
                0 - 7fh
           A = Code to be assigned

Return:

XBIOS 26   Read Scan Code Table

Description:
           Read scan code table from system track to memory.

Entry: C = 1AH

Return: A = 0 - operation successful
            A = 1 - operation unsuccessful

XBIOS 27   Write Scan Code Table

Description:
            Write the current scan code table from memory to
            system track.

Entry: C = 1BH

Return: A = 0 - operation successful
            A <> 0 - operation unsuccessful

XBIOS 28   RESERVED

Entry: C = 1CH

Description: Reserved for future expansion. No operation.

XBIOS 29   RESERVED

Entry: C = 1DH

Description: Reserved for future expansion. No operation.

XBIOS calls 30 - 45 deal with function key tables.   Refer
to Appendix E for a listing of Function Keys.

XBIOS 30   Select Function Key Table

Entry: C = 1EH
            A = Selection Code
                0 - HASCI Table
                1 - TVI-920 Table
                2 - Custom Table

Return: A = 0 - operation successful
            A <> 0 - operation unsuccessful

XBIOS 31   Save Current Function Key Table Pointer

Entry: C = 1FH

XBIOS 32   Restore Funtion Key Table Pointer

Entry: C = 20H

XBIOS 33   Get Selected Function Key Table

Entry: C = 21H
           DE = Address of 1K buffer to hold CFK table

Return: Selected Function Key Table moved to buffer

XBIOS 34   Put Selected Function Key Table

Entry: C = 22H
           DE = Address of 1K buffer containing a user
           defined PFK table

Return: User defined PFK copied over Selected CFK.

XBIOS 35   Save Selected Function Key Table

Entry: C = 23H

Return: Contents of Selected Function Key Table copied to
           save area

XBIOS 36   Restore Selected Function Key Table

Entry: C = 24H

Return: Contents of PFK save area copied over Selected
           Function Keys (only if a XBIOS 35 function
           previously performed)

XBIOS 37   Get Function Key

Entry: C = 25H
           DE = Address of 25 byte buffer
           A = Function Key # (0 - 22H)

Return: Selected function key string moved to buffer

XBIOS 38   Put Function Key

Entry: C = 16H
           DE = Address of 25 byte buffer containing function key
                definition
           A = Funtion Key # (0 - 22H)

Return: Funtion key string in buffer moved to Selected
           Function Key Table

XBIOS 39   Disable System Key

Entry: C = 27H
           A = System Key Number

           key no.   key label   function
             0   bold   toggle bold fonts
             1   italic   toggle italic fonts
             2   size   reserved for future us
e
             3   style   toggle style fonts
             4   control stop   pause (ctl-s)
             5   control graph shift stop   cold boot
             6   control help   status/help display
             7   control print   screen dump

Return: Selected System Key is disabled

XBIOS 40   Enable System Key

Entry: C = 28H
           A = System Key Number

           key numbers and definition same as XBIOS 39

Return: Selected System Key is enabled

XBIOS 41   Read Custom Function Key Table

Description:
           Read custom function key table from system track
           to memory.

Entry: C = 29H

Return: A = 0 - operation successful
           A <> 0 - operation unsuccessful

XBIOS 42   Write Custom Function Key Tables

Entry: C = 2AH

Return: A = 0 - operation successful
           A <> 0 - operation unsuccessful

XBIOS 43   Enable Keyboard Reset at Warm Boot

Entry: C = 2BH

Description: Operation causes XBIOS functions 23, 36 & 32
               to be performed in that order at the next

54

warm boot. The warm boot code resets the
XBIOS 43 request.

XBIOS 44   Perform Warm Boot Reset

Entry: C = 2CH

Description: Performs the warm boot processes normally
                 invoked by XBIOS 43. This function should be
                 used by applications which trap the warm boot
                 vector as a restart mechanism.

XBIOS 45   RESERVED

Entry: C = 2DH

Description: Reserved for future expansion. No operation.

XBIOS 46   Request Memory Bank

Entry: C = 2EH
           A = Bank # to request.

Return: A = 0 - operation successful
           A = 1 - illegal bank # requested
                2 - RAM disk is enabled and contains data
                    Code can use XBIOS 51 to report condition
                    to user.

XBIOS 47   Release Memory Bank

Entry: C = 2FH
           A = Bank # to release

XBIOS 48   Move Block to another Bank

Entry: C = 30H
           DE = Parameter Buffer Address

Buffer Contents: byte 0   - Source Bank (0 - 3)
                          byte 1   - Destination Bank (1 - 3) .
                          bytes 2,3 - Source Address (Intel format)
                          bytes 4,5 - Destination Address (Intel format)
                          byte 6,7 - Byte Count (Intel format)

Return: A = 0 if successful
           A = <> if not successful

XBIOS 49   Call Code in another Bank

55

```
Entry:      C  = 31H
            DE = Destination Address
            A  = Destination Bank (1 - 3)

Return:     A = O  if successful
            A <> O if not successful


XBIOS 50          Jump to Code in another Bank

Entry:      C  = 32H
            DE = Destination Address
            A  = Destination Bank (1 - 3)

Return:     A = O  if successful
            A <> O if not successful


XBIOS 51          Display RAM Disk Overwrite Message

Entry:      C = 33H

Description:      Displays the RAM Disk Overwrite Message.
                 Allows the operator to abort the process or
                 continue.   Upon continuing, RAM disk is
                 cleared and previous Bank requested competed.


XBIOS 52          RESERVED

Entry:      C = 34H

Description:  Reserved for future expansion.   No operation.


XBIOS 53          RESERVED

Entry:      C = 35H

Description:  Reserved for future expansion.   No operation.


XBIOS 54          PSET - Pixel Set/Reset

Entry:      C  = 36H
            DE = X coordinate (0-639)
            HL = Y coordinate (0-399)
            A  = Operation
                 1 - Replace
                 2 - Overstrike
                 3 - Complement
                 4 - Erase
```

```
XBIOS 55          Set Viewport

Entry:     C = 37H
           B = Viewport Number (0..5)
           D = Write/Display Mode
           E = Clear/No-Clear Flag

Description:  Sets current Video View Port.
                Reserved for future expansion.


XBIOS 56          RESERVED

Entry:    C = 38H

Description:  Reserved for future expansion.   No operation.


XBIOS 57          RESERVED

Entry:    C = 39H

Description:  Reserved for future expansion.   No operation.


XBIOS 58          RESERVED

Entry:    C = 3AH

Description:  Reserved for future expansion.   No operation.


XBIOS 59          RESERVED

Entry:    C = 3BH

Description:  Reserved for future expansion.   No operation.


XBIOS 60          Set User Interrupt Vector

Entry:     C  = 3CH
           A  = Interrupt Number to be set
           DE = User Interrupt Service Routine Address
                (in common area.  See XBIOS 65)

     00 - Power Down Detect
     01 - Software Timer #1
     02 - External Interrupt INTF1
     03 - External Interrupt INTF2
     04 - Protected (Keyboard/Serial Port)
     05 - CRT/Light Pen Interrupt
     06 - Floppy Controller Interupt
     07 - Protected (Slave Cascade)
     08 - Printer
```

```
          09 - External Interrupt #1
          10 - Calendar Clock
          11 - External Interrupt #2
          12 - External Interrupt #3
          13 - Protected (Software Timer #2)
          14 - External Interrupt #4
          15 - External Interrupt #5
          16 - Keyboard (Interrupt 4 Decoded)
          17 - Serial Port (Interrupt 4 Decoded)
```

XBIOS 61   Clear User Interrupt Vector

Entry: C = 3DH
          A = Interrupt Number

This routine restores the interrupt to the system default
condition.

XBIOS 62   Get Interrupt Mask

Entry: C = 3FH

On Return:
          DE = Interrrupt Mask

This routine returns the 8259 interrupt mask.

XBIOS 63   Enable Interrupt

Entry: C = 40H
          DE = Interrupt Mask

This routine enables the interrupts that correspond to the
bits in DE that are set to 1 where the mask in register E
affects the master 8259 and the mask in register D affects
the slave 8259.

XBIOS 64   Disable Interrupt

Entry: C = 41H
          DE = Interrupt Mask

This routine disables the interrupts that correspond to the
bits in DE that are set to 1.

XBIOS 65   Get User Common Address

Entry: C = 42H

On Return:
          DE = User Common Address

HL = Bit Map Address

A 512 byte area in Common Ram has been reserved for user
interrupt handlers.   On return DE contains the address of
this area.

A 64 byte bit mask allocation buffer is made available to
the user to designate portions of the 512 byte buffer as
active.   The 64 byte buffer translates to 512 bits, i.e. a
1-to-1 mapping over the 512 byte buffer.   At cold boot the
mask buffer is set to all 0 to indicate a clear buffer.   It
is the responsibility of each routine adding/deleting code
in the user buffer to maintain the bit map where:

        0 - byte not allocated
        1 - byte allocated

XBIOS 66   Attach MTERM Interrupt Driver

Entry: C = 43H

Description: Attaches the MTERM interrupt code to
                 the serial port vector.

XBIOS 67   Detach MTERM Interrupt Drivers

Entry: C = 44H

Description: Detaches MTERM Code from serial port
                 vector and reattaches bios serial port code.

XBIOS 68-239   RESERVED FOR FUTURE EXPANSION

XBIOS 240-255   RESERVED FOR OEM/VAR FUNCTION IMPLEMENTATION

4.0   SYSTEM LEVEL DESCRIPTION

4.1   PUBLICATIONS

User Manual

Informs the User of CP/M-80 R2.2 on the Epson QX-10 System
of the specific characteristics of this customization of
CP/M-80 R2.2 of which they should be aware.   This would
include the use of the keyboard and a description of the
video display programming interface as well as unique
utility programs.

Programmer's Manual

The   External Reference Specification plus the Digital

Research CP/M-80 documentation provides the technical information for the applications programmer who must customize some application program (such as full screen word processor) to the Epson QX-10 System.

Maintenance Manual

This document contains the technical specifications and program logic of the Customized BIOS and utilities for CP/M-80 R2.2 on the Epson QX-10 system. This manual would be used by those who are responsible for maintaining this customization of CP/M-80 R2.2. This ERS and the program source listings provide this information.

4.2   EQUIPMENT CONFIGURATION

HASCI keyboard, 2 diskette drives, Monochrome display, 256K RAM, 1 parallel port, and one RS232C serial port.

4.3   INTERFACES WITH OTHER SOFTWARE

Although not specifically addressed in this customization, the ground work is laid in place to not preclude the interface with the CP/M Plus, MP/M-80 and CP/NET-80 software products.   Support for Synchronous communication capability using the serial ports is not addressed in this implementation.   Additional marketing requirements are needed in order to externally specify this feature.

4.4   RELIABILITY, AVAILABILITY, SERVICEABILITY

All errors will be reported to the user.   Recovery will be attempted if possible. Any unknown errors will cause a warm boot of CP/M-80 R2.2.

APPENDICES

Appendix A.1

HASCI-1 Keyboard Mapping

KEY	SCAN CODE	AL	AU	CL	CU	GL	GU
STOP	73	F01	00	S05	00	00	00
HELP	72	F02	F19	S06	00	00	00
COPYDISK	71	F03	F20	00	00	00	00
UNDO	01	F04	F21	00	00	00	00

KEY	SCAN CODE	AL	AU	CL	CU	GL	GU	
STORE	03	F05	F22	00	00	00	00	
RETRIEVE	04	F06	F23	00	00	00	00	
PRINT	05	F07	F24	S07	00	00	00	
INDEX	06	F08	F25	00	00	00	00	
MAIL	07	F09	F26	00	00	00	00	
EDIT	09	F10	F27	00	00	00	00	N/A HASCI-1
MENU	08	F11	F28	00	00	00	00	
CALC	0A	F12	F29	00	00	00	00	
SCHED	0B	F13	F30	00	00	00	00	
DRAW	0C	F14	F31	00	00	00	00	
BOLD	0E	F15	F32	S01	00	00	00	
ITALIC	0F	F16	F33	S02	00	00	00	
SIZE	1F	F17	F34	S03	00	00	00	
STYLE	1E	F18	F35	S04	00	00	00	

KEY	SCAN CODE	AL	AU	CL	CU	GL	GU
MAR REL	74	1B	1B	1B	1B	00	00
^	75	BB	5E	00	1E	A0	AC
! 1	76	31	21	11	01	A1	AD
@ 2	61	32	40	12	00	A2	AE
# 3	62	33	23	13	03	A3	AF
$ 4	63	34	24	14	04	A4	A9
% 5	64	35	25	15	05	A5	AA
6	65	36	C4	16	00	E6	E4
& 7	66	37	26	17	07	DD	DA
* 8	67	38	2A	18	0A	ED	EA
(9	68	39	28	19	08	FD	FA
) 0	69	30	29	10	09	F6	F4
_ -	6A	2D	5F	0D	1F	60	C6
+ =	6B	3D	2B	1D	0B	7C	C7
\	6C	5C	BD	1C	00	7E	C0
|X>	6D	08	08	08	08	00	00

Appendix A.1 (cont.)

KEY	SCAN CODE	AL	AU	CL	CU	GL	GU
TAB	77	09	09	09	09	00	00
Q q	51	71	51	11	11	A6	B8
W w	52	77	57	17	17	A7	A8
E e	53	65	45	05	05	B0	B9
R r	54	72	52	12	12	B1	BA
T t	55	74	54	14	14	E2	E0
Y y	56	79	59	19	19	F2	F0
U u	57	75	55	15	15	E9	F9
I i	58	69	49	09	09	DE	DB
O o	59	6F	4F	0F	0F	EE	EB
P p	5A	70	50	10	10	FE	FB
	5B	BE	BF	00	00	D7	D8
[<	5C	3C	5B	1C	1B	7B	C2
] >	5D	3E	5D	1E	1D	7D	C3

KEY	SCAN CODE						
TAB REL	41	00	00	00	00	00	00
SHIFT LOCK	42	00	00	00	00	00	00
A a	43	61	41	01	01	CC	CD
S s	44	73	53	13	03	B2	B3
D d	45	64	44	04	04	BC	B4
F f	46	66	46	06	06	B7	B6
G g	47	67	47	07	07	E3	E1
H h	48	68	48	08	08	F3	F1
J j	49	6A	4A	0A	0A	E8	F8
K k	4A	6B	4B	0B	0B	DF	DC
L l	4B	6C	4C	0C	0C	EF	EC
: ;	4C	3B	3A	1B	1A	FF	FC
" '	4D	27	22	07	02	D7	C1
RETURN	4E	0D	0D	0D	0D	00	00
TAB SET	78	00	00	00	00	00	00
SHIFT	86 87	00	00	00	00	00	00
Z z	33	7A	5A	1A	1A	CE	CF
X x	34	78	58	18	18	AB	B5
C c	35	63	43	03	03	D0	D4
V v	36	76	56	16	16	D1	D5
B b	37	62	42	02	02	D2	C5
N n	38	6E	4E	0E	0E	D3	D6
M m	39	6D	4D	0D	0D	E7	E5
, ,	3A	2C	2C	0C	0C	C8	CA
. .	3B	2E	2E	0E	0E	C9	CB
? /	4F	2F	3F	0F	0F	F7	F5
SHIFT	84 85	00	00	00	00	00	00
CTRL	8A 8B	00	00	00	00	00	00
SPACE BAR	32	20	20	20	20	20	20
GRPH SHIFT	8C 8D	00	00	00	00	00	00
CTRL	8E 8F	00	00	00	00	00	00

Appendix A.1 (cont.)

KEY	SCAN CODE	AL	AU	CL	CU	GL	GU
<X|	6E	7F	7F	7F	7F	00	00
LINE	6F	0A	0A	0A	0A	00	00
INSERT	5E	00	00	00	00	00	00
WORD	5F	1E	1E	1E	1E	00	00
UP ARROW	3C	0B	12	0B	12	00	00
<--	3D	08	01	08	01	00	00
-->	3E	0C	06	0C	06	00	00
DOWN ARROW	3F	0A	03	0A	03	00	00

DEC.TAB	2F	00	00	00	00	00	00	
DIVISION	2E	2F	2F	2F	2F	00	00	
X	2D	2A	2A	2A	2A	00	00	
–	1C	2C	2C	2C	2C	00	00	+/–
7	2B	37	37	37	37	00	00	
8	2A	38	38	38	38	00	00	
9	29	39	39	39	39	00	00	
+	2C	2B	2B	2B	2B	00	00	–
4	1B	34	34	34	34	00	00	
5	1A	35	35	35	35	00	00	
6	19	36	36	36	36	00	00	
=	28	3D	3D	3D	3D	00	00	+
1	27	31	31	31	31	00	00	
2	26	32	32	32	32	00	00	
3	25	33	33	33	33	00	00	
ENTER	15	0D	0D	0D	0D	00	00	ENTER =
0	17	30	30	30	30	00	00	
.	16	2E	2E	2E	2E	00	00	

```
LEGEND:        AL   - NO SHIFT KEYS
               AU   - SHIFT
               CL   - CONTROL
               CU   - CONTROL SHIFT
               GL   - GRAPH SHIFT
               GU   - GRAPH SHIFT SHIFT
```

APPENDIX B

There are four printer error messages described in Appendix
B.1, and four disk error messages described in Appendix B.2.
All situations have in common the fact that the User is
prompted for certain decisions; namely, for the printer the
User is prompted for a decision to: "(R)etry/(A)bort" and
for the disk the User is prompted to select a decision from
four alternatives "(R)etry/(A)bort/(C)ontinue/(I)gnore".

The effect of each decision is as follows:

    (R)etry - Attempt I/O operation again.

    (A)bort - Cancel current operation and program.
              Invoke a system warmstart.

    (C)ontinue - Continue operation and return error
                 code to BDOS.

    (I)gnore - Alter disk I/O return code to indicate

a sucessful I/O operation and return
to BDOS.

B.1 PRINTER ERROR AND STATUS MESSAGES

The following are the printer error and status messages:

PRINTER NOT CONNECTED - (R)etry/(A)bort

Cause: The printer is disconnected from the system.

PRINTER POWER OFF - (R)etry/(A)bort

Cause: The printer is connected but power is off.

PRINTER OFFLINE - (R)etry/(A)bort

Cause: The printer is connected and powered on, but
offline.

PRINTER PAPER OUT - (R)etry/(A)bort

Cause: The printer is connected, powered on, online but out
of paper.

B.2 FLOPPY DISK ERROR AND STATUS MESSAGES

The following are the floppy disk error and status messages:

DRIVE X - SELECT ERROR: (R)etry/(A)bort

Cause: A non-existent drive has been selected.

DRIVE X - SEEK ERROR: (R)etry/(A)bort/(C)ontinue/(I)gnore

Possible Causes:
        - a bad diskette
        - corrupted data
        - erroneous program instruction

DRIVE X - RD/RW ERROR: (R)etry/(A)bort/(C)ontinue/(I)gnore

Possible Causes:
        - a bad diskette
        - corrupted data
        - the diskette has a write protect tab on it

DRIVE X - NOT READY: (R)etry/(A)bort/(C)ontinue/(I)gnore

Possible Causes:
       - the 'PUSH' button on the disk drive has not been depressed
       - a diskette has not been inserted in the selected drive
       - the selected drive does not exist

APPENDIX C

C.1 TVI-920 CONTROL AND ESCAPE SEQUENCES

FUNCTION	CTRL/ESC SEQ	HEX CODE	CHR DRV	GRPH DRV
Bell	CTRL G	07	X	X
Carriage Return	CTRL M	0D	X	X
Cursor Left	CTRL H	08	X	X
Cursor Right	CTRL L	0C	X	X
Cursor Down	CTRL J	0A	X	X
Cursor Up	CTRL K	0B	X	X
Cursor Home	CTRL ^	1E	X	X
Address Cursor	* ESC = rc	1B,3D rc	X	X
Read Cursor	ESC ?	1B,3F	X	X
Linefeed	CTRL J	0A	X	X
Tab	CTRL I	09	X	X
Backtab	ESC I	1B,49	X	X
Clear Screen	CTRL Z	1A	X	X
Clear All To Space	ESC +	1B,2B	X	X
Character Insert	ESC Q	1B,51	X	X
Character Delete	ESC W	1B,57	X	X
Line Insert	ESC E	1B,45	X	X
Line Delete	ESC R	1B,52	X	X
Reverse Video	ESC j	1B,6A	X	X
End of Reverse Video	ESC k	1B,6B	X	X
Start Underline	ESC l	1B,6C	**	X
End Underline	ESC m	1B,6D	**	X
Start Blink Field	ESC ^	1B,5E	X	**
Start Blank Field	ESC	1B,20	X	**
End Blink/Blank	ESC q	1B,71	X	**
Erase EOL with Spaces	ESC T	1B,54	X	X
Erase EOP with Spaces	ESC Y	1B,59	X	X
Lock Keyboard	ESC #	1B,23	X	X
Unlock Keyboard	ESC "	1B,22	X	X
High Intensity Off	ESC (	1B,28	X	X
High Intensity On	ESC)	1B,29	X	X
New Line	CTRL _	1F		
Set Block Mode	ESC B	1B,42		
Set Conversation Mode	ESC C	1B,43		
Protect Mode On	ESC &	1B,26		
Protect Mode Off	ESC '	1B,27		
Set Column TAB	ESC 1	1B,31		

```
Clear  TAB          ESC 2      1B,32
Clear All  TAB      ESC 3      1B,33
TAB                 ESC i      1B,69
```

FUNCTION	CTRL/ESC SEQ	HEX CODE	CHR DRV	GRPH DRV
Send Line Unprotected to Cursor Position	ESC 4	1B,34		
Send Page Unprotected to Cutsor Position	ESC 5	1B,35		
Send Whole Page Unprotected	ESC S	1B,53		
Send Line All to Cursor Position	ESC 6	1B,36		
Send Page All to Cursor Position	ESC 7	1B,37		
Send Whole Page	ESC s	1B,73		
Clear All to NULL	ESC *	1B,2A		
Clear Unprotected to NULL	ESC :	1B,3A		
Line Erase to NULL	ESC t	1B,74		
Page Erase to NULL	ESC y	1B,79		
Toggle Page	ESC K	1B,4B		
Load Cursor (PAGE,ROW,COLUMN)	ESC -	1B,2D		
Read Cursor (PAGE,ROW,COLUMN)	ESC /	1B,2F		
Auto Flip On	ESC v	1B,76		
Auto Flip Off	ESC w	1B,77		
Extension Port On	ESC @	1B,40		
Extension Port Off Page Print Mode On	ESC A	1B,41		
Print Page	ESC P	1B,50	X	X

X – Function implemented.

* NOTE: Direct cursor positioning is accomplished by the following escape sequence:

ESC = Row+20H Col+20H where Row = 1-24, Col = 1-80

** NOTE: These attributes will have no effect but will result in a space (blank) being written in their place. This will insure proper cursor positioning relative to the TVI-920.

C.2 QX-10 CONTROL AND ESCAPE SEQUENCES

FUNCTION	CTRL/ESC SEQ	HEX CODE	CHR DRV	GRPH DRV
Set Font	ESC X 1 n	1B,58,31,n		X
Load Font-character	ESC X 2 n	1B,58,32,n		X

```
Sub-script                    ESC X 3     1B,58,33              X
Super-script                  ESC X 4     1B,58,34              X
Normal-script                 ESC X 5     1B,58,35              X
LED On                        ESC X 6 n   1B,58,36,n      X     X
LED Off                       ESC X 7 n   1B,58,37,n      X     X
Foreground Color              ESC X 8     1B,58,38,n            X
Background Color              ESC X 9     1B,58,39,n            X
Set Reverse Video             ESC X A     1B,58,41              X
Reset Reverse Video           ESC X B     1B,58,42              X
Set Underline                 ESC X C     1B,58,43              X
Reset Underline               ESC X D     1B,58,44              X
Cursor on                     ESC X E     1B,58,45        X     X
Cursor off                    ESC X F     1B,58,46        X     X
```

   X — Function implemented.

C.3   CONTROL AND ESCAPE SEQUENCE DESCRIPTIONS

Set Font — select a font from the set of available fonts

```
Escape Sequence : ESC     X      1       N
Hex Codes       : 1B      58     31      00..06
```

N is the number of the selected font from the following set:


```
        FONT                               N

Standard Font                             00h
BOLD Standard Font                        01h
Italics Font                              02h
BOLD Italics Font                         03h
User defined Style Font                   04h
BOLD Style                                05h
```


Load Font-character — load an 8 X 16 pattern for a selected
                      character in the user defined style
                      font

```
Escape Sequence : ESC  X  2     ordinal value      P1...P16
Hex Sequence    : 1B   58 32    00..127               —
```


Ordinal Value is the ASCII code for the character that is
being defined.

P1 to P16 are 16 pattern bytes of the character.

PLEASE SEE GRAPHICS CHARACTER DEFINITION APPENDIX FOR FURTHER DETAILS.

Sub-Script - write all subsequent characters in subscript mode

```
Escape sequence : ESC    X    3
HEX Code        : 1B     58   33
```

All subsequent characters are selected from a special half-height character font until the normal-script escape sequence is issued.

Super-Script - write all subsequent characters in super-script mode

```
Escape sequence : ESC    X    4
HEX Code        : 1B     58   34
```

All subsequent characters are selected from a special half-height character font until the normal-script escape sequence is issued.

Normal-Script - change to the currently selected font

```
Escape sequence : ESC    X    5
HEX Code        : 1B     58   35
```

If in Sub- or Super-script mode, will revert to normal mode. Subsequent characters are written from the currently selected font.

LED ON - turn the selected LED on

```
Escape sequence : ESC    X    6    N
HEX Code        : 1B     58   36   01..08
```

N is the number of the selected LED; numbered from 1 to 8

LED OFF - turn the selected LED off

        Escape sequence : ESC   X   7   N
        HEX code   : 1B   58   37   01..08

N is the same as for LED ON above

Foreground Color - set the foreground color to the selected
                   value

        Escape sequence : ESC   X   8   N
        HEX Code   : 1B   58   38   00..07

N is the selected color from the following table:

    COLOR   N

                              00
                              01
                              02
                              03
                              04
                              05
                              06
                              07

Background Color - set the background color to the
selected value

        Escape sequence : ESC   X   9   N
        HEX code   : 1B   58   39   00..07

N may take on values from the above table.

Set Reverse Video - all subsequent characters are written in
reverse video mode

        Escape sequence : ESC   X   A
        HEX Code   : 1B   58   41

This is the mode attribute version of reverse video.   All

subsequent characters are written in reverse video until a
reset reverse video escape sequence is issued.

Reset Reverse Video - cancels reverse video mode (if active)

        Escape sequence : ESC   X   B
        HEX Code   : 1B   58   42

All subsequent characters are written in standard mode

Set Underline - all subsequent characters are underlined

        Escape sequence : ESC   X   C
        HEX Code   : 1B   58   43

All subsequent written characters are underlined until a
RESET Underline escape sequence is sent.

Reset Underline - cancels underline mode (if active)

        Escape sequence : ESC   X   D
        HEX Code   : 1B   58   44

All subsequent characters are written in standard mode.

Cursor On - allows the cursor to be displayed

        Escape sequence : ESC   X   E
        HEX Code   : 1B   58   45

Cursor is displayed

Cursor Off - cursor is not displayed

        Escape sequence : ESC   X   F
        HEX Code   : 1B   58   46

Cursor is not displayed.

APPENDIX D

D.1   Supported Optional Diskette Formats

FORMAT	DENSITY	SIDES/ DISK	TRKS/ SIDE	SECTORS/ TRACK	BYTES/ SECTOR	SYSTEM TRACKS
QX-10 380K	DOUBLE	2	40	10	512	2
QX-10 300K	DOUBLE	2	40	16	256	2
MFCPM	DOUBLE	2	40	16	256	4
IBMD	DOUBLE	2	40	9	512	2
IBMS	DOUBLE	1	40	8	512	2

The IBM formats above refer to CP/M-86 implementations.

APPENDIX E

E.1 System Keys

System Keys invoke a BIOS function to occur at the time the
key is depressed.   Initial System Key functions are:

    Toggle Bold Font (Graphics Driver Only)
    Toggle Italics Font (Graphics Driver Only)
    Size Key (reserved for future use)
    Toggle Style Font (Graphics Driver Only)
    Pause
    Cold Boot
    System Status Display
    Screen Dump

The user cannot add or change System Keys.   The System Key
definitions   are   set   at   System   Generation   time.   An
application program can disable (and re-enable) a System Key
in order to allow the key to be redefined as a function key
so that the application can process it (a wordprocessor may
wish to provide font capabilities and would require the font
keys).

The VAR and OEM can redefine the System Keys described above
as well as adding new System Keys.   There is no upper limit.

E.2 Function Keys

Functions Keys differ from the normal set of keys in that when depressed a Function Key will insert a string of characters (as opposed to one character) in the keyboard buffer. Any key on the keyboard may be assigned as a Function Key. Tables within the keyboard support code designate a unique scan code and shift keys combination (shift, control, graph shift) as a Function Key. Three tables for function key mappings are provided:

> HASCI - a QX-10 implementation which highlights QX-10 features and keyboard layout.

> TVI920 - a TVI-920 implementation which provides function key definitions as defined by Televideo for programs requiring the TVI-920 mapping.

> CUSTOM - a general function key table which the user can modify through SETUP or an application program. These modifications can be temporary or can be made permanent.

VAR's and OEM's have the ability to generate a baseline function key mappings that support their particular environment.

The user cannot modify the tables which define the particular scan codes that identify the function keys. However, the user can modify the character strings produced by the function keys.

As with System Keys, Function Keys can be enabled/disabled by an application program. Additionally, function keys can be protected such that modification by SETUP is disabled.

Following is the TVI-920 function key table.

```
;*********************************************************************
;
;              FUNCTION KEY SCAN CODE TABLE - TVI-920
;
;      BYTE 1 - SCAN CODE
;      BYTE 2 - ATTRIBUTES
;              BITS 0-2 - SCAN MASK
;      BYTES 3,4 - OFFSET INTO STRING TABLE
;
;*********************************************************************

;      TELEVIDEO-920 FUNCTION KEYS TABLE
;      UNSHIFTED FUNCTION KEYS

@FK920:
        DB      73H,00H
        DW      0 * FKOFFSET
```

```
        DB      72H,00H
        DW      1 * FKOFFSET
        DB      71H,00H
        DW      2 * FKOFFSET
        DB      01H,00H
        DW      3 * FKOFFSET
        DB      03H,00H
        DW      4 * FKOFFSET
        DB      04H,00H
        DW      5 * FKOFFSET
        DB      05H,00H
        DW      6 * FKOFFSET
        DB      06H,00H
        DW      7 * FKOFFSET
        DB      07H,00H
        DW      8 * FKOFFSET
        DB      09H,00H
        DW      9 * FKOFFSET
        DB      08H,00H
        DW      10 * FKOFFSET
        DB      0AH,00H
        DW      11 * FKOFFSET
        DB      0BH,00H
        DW      12 * FKOFFSET
        DB      0CH,00H
        DW      13 * FKOFFSET
        DB      0EH,00H
        DW      14 * FKOFFSET
        DB      0FH,00H
        DW      15 * FKOFFSET
        DB      1FH,00H
        DW      16 * FKOFFSET
        DB      1EH,00H
        DW      17 *FKOFFSET

;UNSHIFTED FUNCTION KEYS

        DB      72H,01H
        DW      18 * FKOFFSET
        DB      71H,01H
        DW      19 * FKOFFSET
        DB      01H,01H
        DW      20 * FKOFFSET
        DB      03H,01H
        DW      21 * FKOFFSET
        DB      04H,01H
        DW      22 * FKOFFSET
        DB      05H,01H
        DW      23 * FKOFFSET
        DB      06H,01H
        DW      24 * FKOFFSET
        DB      07H,01H
        DW      25 * FKOFFSET
        DB      09H,01H
        DW      26 * FKOFFSET
```

```
              DB        08H,01H
              DW        27 * FKOFFSET
              DB        0AH,01H
              DW        28 * FKOFFSET
              DB        0BH,01H
              DW        29 * FKOFFSET
              DB        0CH,01H
              DW        30 * FKOFFSET
              DB        0EH,01H
              DW        31 * FKOFFSET
              DB        0FH,01H
              DW        32 * FKOFFSET
              DB        1FH,01H
              DW        33 * FKOFFSET
              DB        1EH,01H
              DW        34 *FKOFFSET

FKOFFSET EQU      25                              ;OFFSET MULTIPLIER


;***********************************************************
;
;        PROGRAMMABLE FUNCTION KEY STRINGS
;
;        BYTE 1 - ATTRIBUTES
;                 BIT 7   - ENABLED/DISABLED
;                 BIT 6   - PROTECTED
;                 BIT 5   - CARRIAGE RETURN DELIMITED
;                 BIT 0-4 - STRING LENGTH (MAX = 24)
;        BYTES 2-25 - STRING
;
;***********************************************************

@FS920:
              DB        80H                       ;STOP
              DS        24
              DB        25H,'SETUP              '  ;HELP
              DB        28H,'COPYDISK           '  ;COPYDISK
              DB        22H,01H,40H               ;UNDO
              DS        22
              DB        22H,01H,41H               ;STORE
              DS        22
              DB        22H,01H,42H               ;RETRIEVE
              DS        22
              DB        22H,01H,43H               ;PRINT
              DS        22
              DB        22H,01H,44H               ;INDEX
              DS        22
              DB        22H,01H,45H               ;MAIL
              DS        22
              DB        22H,01H,46H               ;MENU
              DS        22
              DB        22H,01H,47H               ;EDIT
              DS        22
              DB        22H,01H,48H               ;CALC
              DS        22
```

```
        DB      22H,01H,49H                    ;SCHED
        DS      22
        DB      22H,01H,4AH                    ;DRAW
        DS      22
        DB      80H                            ;BOLD
        DS      24
        DB      80H                            ;ITALIC
        DS      24
        DB      80H                            ;SIZE
        DS      24
        DB      80H                            ;STYLE
        DS      24

;SHIFTED FUNCTION KEYS

        DB      80H                            ;HELP
        DS      24
        DB      80H                            ;COPYDISK
        DS      24
        DB      22H,01H,60H                    ;UNDO
        DS      22
        DB      22H,01H,61H                    ;STORE
        DS      22
        DB      22H,01H,62H                    ;RETREIVE
        DS      22
        DB      22H,01H,63H                    ;PRINT
        DS      22
        DB      22H,01H,64H                    ;INDEX
        DS      22
        DB      22H,01H,65H                    ;MAIL
        DS      22
        DB      22H,01H,66H                    ;MENU
        DS      22
        DB      22H,01H,67H                    ;EDIT
        DS      22
        DB      22H,01H,68H                    ;CALC
        DS      22
        DB      22H,01H,69H                    ;SCHED
        DS      22
        DB      22H,01H,6AH                    ;DRAW
        DS      22
        DB      80H                            ;BOLD
        DS      24
        DB      80H                            ;ITALIC
        DS      24
        DB      80H                            ;SIZE
        DS      24
        DB      80H                            ;STYLE
        DS      24

        DS      9                    ;TAKE UP SPACE FOR 1K BOUNDARY ON DISK I
        DS      9                    ;TAKE UP SPACE FOR 1K BOUNDARY ON DISK I
        DS      9                    ;TAKE UP SPACE FOR 1K BOUNDARY ON DISK I
```

/0

APPENDIX F

F.1   Status Line

The Status Line is used to display system error messages and system data.   The system error messages are described in Appendix B.   Following is description of system data maintained on the Status Line.

Appendix G — System Data Page

Entry	Offset	Bytes	Description
EYEBALL	00	21	Visual locator
RELEASE	22	1	Bios Release Level — 'B'
REVLVL	23	3	Bios Revision Level — '220'
ERREC	25	1	Disk Error Recovery 0 — disabled 1 — enabled
ERRDIAG	26	1	Disk Diagnostics 0 — disabled 1 — enabled
CLOCK	27	1	Date — Time Display 0 — disabled 1 — enabled
CRTWRAP	28	1	Auto Line Wrap 0 — disabled 1 — enabled
CBLINK	29	1	Cursor Blink 0 — disabled 1 — enabled
@sysres	30	1	Reserved for screen dump formatting
TYPAMAT	31	1	Typamatic 0 — disabled 1 — enabled
IOBYTE	32	1	CP/M IOBYTE
SIO1BD	33	1	7201 Baud Rate ;see SETUP for 0 — none 1 — 50 2 — 75 3 — 110 4 — 134 5 — 150 6 — 300 7 — 600

```
                                      8 - 1200
                                      9 - 1800
                                     10 - 2400
                                     11 - 3600
                                     12 - 4800
                                     13 - 7200
                                     14 - 9600
```

Entry	Offset	Bytes	Description
SIO1PRO	34	1	7201 Protocol 0 - none 1 - ETX/ACK 2 - RTS/CTS 3 - XON/XOFF
SIO1PAR	35	1	7201 Parity Bits 0 - none 1 - odd 2 - even
SIO1STP	36	1	7201 Stop Bits 0 - 1 1 - 1.5 2 - 2
SIO1DTA	37	1	7201 Data Bits 0 - 5 1 - 6 2 - 7 3 - 8
AUTO	38	1	Turnkey Cold Boot 0 - disabled 1 - enabled
DISPM	39	1	Display Unit Bit 7 Masking 0 - disabled 1 - enabled
SERM	40	1	Serial Port Bit 7 Masking 0 - disabled 1 - enabled
SHFTLOK	41	1	SHIFT LOCK Interpretation 0 - Caps Lock 1 - Shift Lock
FUNCTBL	42	1	Function Table Selector 0 - HASCI 1 - TVI-920 2 - Custom
RAMDISK	43	1	RAM Disk Active 0 - disabled

                                        1 - enabled

        Entry   Offset Bytes   Description

        PRINTER   44   1   Parallel Port Printer Handshake Support
                                      0 - none
                                      1 - undefined
                                      2 - centronics
                                      3 - FX-80
                                      4 - FX-100
                                      5 - RX-80
                                      6 - RX-100
                                      7 - MX-80
                                      8 - MX-100
                                      9 - Comrex CR-1
                                      10 - Comrex CR-2
                                      11 - Comrex CR-3

        DSKFMT   45   1   Right Diskette Format
                                      0 - QX10 - 380k
                                      1 - QX10 - 300k
                                      2 - MFCP/M
                                      3 - IBM 1
                                      4 - IBM 2

        VIDTYP   46   1   CRT Driver enabled
                                      0 - Character
                                      1 - Bit Image

        PARMASK   47   1   Parallel Port 7 bit masking
                                      0 - disabled
                                      1 - enabled

        SERINT   48   1   Serial Port Interrupt Handler Enabled
                                      0 - Polled Driver
                                      1 - Interrupt Driver

        SSHEET   49   1   Single Sheet Mode Support
                                      0 - disabled
                                      1 - enabled

        DRVASG   64   16   Disk Drive Assignments at Cold Boot
                                      1 - Left Diskette
                                      2 - Right Diskette
                                      3 - RAM Disk
                                      4 - Logical Hard Disk 1
                                      5 - Logical Hard Disk 2

        CURASG   80   16   Current Drive Assigments

        AUTOLEN   96   1   Cold Boot Turnkey String Length
                                      0-24

        AUTOBOOT   97   24   Cold Boot Turnkey String

Appendix H

Fonts Tables

The fonts table for the standard font is attached as
follows.


```
;
;  Standard Font
;

spc OOH,OOH,OOH,OOH,OOH,OOH,OOH,OOH,OOH,OOH,OOH,OOH,OOH,OOH,OOH,OOH
!   O8H,OOH,OOH,O8H,OOH,OOH,OOH,OOH,O8H,O8H,O8H,O8H,O8H,O8H,O8H,O8H
"   OOH,OOH,OOH,OOH,OOH,OOH,OOH,OOH,6CH,6CH,24H,24H,OOH,OOH,OOH,OOH
#   24H,24H,24H,OOH,OOH,OOH,OOH,OOH,OOH,24H,24H,24H,7EH,24H,24H,7EH
$   48H,49H,3EH,O8H,O8H,OOH,OOH,OOH,O8H,O8H,3EH,49H,O9H,O9H,3EH,48H
%   64H,92H,92H,61H,OOH,OOH,OOH,OOH,46H,29H,29H,16H,1OH,O8H,O8H,O4H
&   51H,21H,22H,5CH,OOH,OOH,OOH,OOH,OCH,12H,12H,OCH,O4H,OAH,O9H,51H
'   OOH,OOH,OOH,OOH,OOH,OOH,OOH,OOH,18H,18H,1OH,O8H,O4H,OOH,OOH,OOH
(   1OH,1OH,2OH,4OH,OOH,OOH,OOH,OOH,4OH,2OH,1OH,1OH,O8H,O8H,O8H,O8H
)   O4H,O4H,O2H,O1H,OOH,OOH,OOH,OOH,O1H,O2H,O4H,O4H,O8H,O8H,O8H,O8H
*   O8H,OOH,OOH,OOH,OOH,OOH,OOH,OOH,O8H,49H,2AH,1CH,O8H,1CH,2AH,49H
+   O8H,O8H,O8H,OOH,OOH,OOH,OOH,OOH,OOH,OOH,O8H,O8H,O8H,O8H,7FH,O8H
,   OCH,OCH,O8H,O4H,O2H,OOH,OOH,OOH,OOH,OOH,OOH,OOH,OOH,OOH,OOH,OOH
-   OOH,OOH,OOH,OOH,OOH,OOH,OOH,OOH,OOH,OOH,OOH,OOH,OOH,OOH,3EH,OOH
/   O4H,O2H,O2H,O1H,O1H,OOH,OOH,OOH,4OH,2OH,2OH,1OH,1OH,O8H,O8H,O4H
O   41H,41H,22H,1CH,OOH,OOH,OOH,OOH,1CH,22H,41H,41H,41H,41H,41H,41H
1   O8H,O8H,O8H,O8H,OOH,OOH,OOH,OOH,O8H,OCH,OAH,O8H,O8H,O8H,O8H,O8H
2   O4H,O2H,O1H,7FH,OOH,OOH,OOH,OOH,1CH,22H,41H,41H,4OH,2OH,1OH,O8H
3   4OH,41H,22H,1CH,OOH,OOH,OOH,OOH,1CH,22H,41H,4OH,2OH,1CH,2OH,4OH
4   2OH,2OH,2OH,2OH,OOH,OOH,OOH,OOH,2OH,3OH,28H,28H,24H,22H,21H,7FH
5   4OH,41H,22H,1CH,OOH,OOH,OOH,OOH,7FH,O1H,O1H,O1H,1DH,23H,4OH,4OH
6   41H,41H,22H,1CH,OOH,OOH,OOH,OOH,1CH,22H,41H,O1H,O1H,1DH,23H,41H
7   1OH,O8H,O8H,O8H,OOH,OOH,OOH,OOH,7FH,4OH,4OH,2OH,2OH,2OH,1OH,1OH
8   41H,41H,22H,1CH,OOH,OOH,OOH,OOH,1CH,22H,41H,41H,22H,1CH,22H,41H
9   4OH,41H,22H,1CH,OOH,OOH,OOH,OOH,1CH,22H,41H,41H,41H,62H,5CH,4OH
:   OOH,OCH,OCH,OOH,OOH,OOH,OOH,OOH,OOH,OOH,OOH,OCH,OCH,OOH,OOH,OOH
;   OOH,18H,18H,O8H,O4H,OOH,OOH,OOH,OOH,OOH,OOH,18H,18H,OOH,OOH,OOH
<   O4H,O8H,1OH,2OH,4OH,OOH,OOH,OOH,4OH,2OH,1OH,O8H,O4H,O2H,O1H,O2H
=   OOH,OOH,OOH,OOH,OOH,OOH,OOH,OOH,OOH,OOH,OOH,7EH,OOH,OOH,OOH,7EH
>   1OH,O8H,O4H,O2H,O1H,OOH,OOH,OOH,O1H,O2H,O4H,O8H,1OH,2OH,4OH,2OH
?   OOH,OOH,O8H,O8H,OOH,OOH,OOH,OOH,1CH,22H,41H,41H,2OH,1OH,O8H,O8H
@   51H,51H,51H,2EH,OOH,OOH,OOH,OOH,1CH,22H,41H,4OH,5OH,5CH,52H,51H
A   41H,41H,41H,41H,OOH,OOH,OOH,OOH,1CH,22H,41H,41H,41H,7FH,41H
B   41H,41H,21H,1FH,OOH,OOH,OOH,OOH,1FH,21H,41H,41H,21H,1FH,21H,41H
C   41H,41H,22H,1CH,OOH,OOH,OOH,OOH,1CH,22H,41H,41H,O1H,O1H,O1H,O1H
D   41H,41H,21H,1FH,OOH,OOH,OOH,OOH,1FH,21H,41H,41H,41H,41H,41H,41H
E   O1H,O1H,O1H,7FH,OOH,OOH,OOH,OOH,7FH,O1H,O1H,O1H,O1H,3FH,O1H,O1H
F   O1H,O1H,O1H,O1H,OOH,OOH,OOH,OOH,7FH,O1H,O1H,O1H,O1H,3FH,O1H,O1H
G   41H,41H,62H,5CH,OOH,OOH,OOH,OOH,1CH,22H,41H,41H,O1H,O1H,71H,41H
H   41H,41H,41H,41H,OOH,OOH,OOH,OOH,41H,41H,41H,41H,41H,7FH,41H,41H
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I   08H,08H,08H,08H,00H,00H,00H,00H,08H,08H,08H,08H,08H,08H,08H,08H
J   10H,11H,11H,0EH,00H,00H,00H,00H,10H,10H,10H,10H,10H,10H,10H,10H
K   09H,11H,21H,41H,00H,00H,00H,00H,41H,21H,11H,09H,05H,03H,03H,05H
L   01H,01H,01H,7FH,00H,00H,00H,00H,01H,01H,01H,01H,01H,01H,01H,01H

M   41H,41H,41H,41H,00H,00H,00H,00H,41H,63H,63H,55H,55H,49H,49H,41H
N   51H,61H,61H,41H,00H,00H,00H,00H,41H,43H,43H,45H,45H,49H,49H,51H
O   41H,41H,22H,1CH,00H,00H,00H,00H,1CH,22H,41H,41H,41H,41H,41H,41H
P   01H,01H,01H,01H,00H,00H,00H,00H,1FH,21H,41H,41H,21H,1FH,01H,01H
Q   41H,51H,22H,5CH,00H,00H,00H,00H,1CH,22H,41H,41H,41H,41H,41H,41H
R   21H,21H,41H,41H,00H,00H,00H,00H,1FH,21H,41H,41H,21H,1FH,11H,11H
S   41H,41H,22H,1CH,00H,00H,00H,00H,1CH,22H,41H,41H,02H,0CH,30H,40H
T   08H,08H,08H,08H,00H,00H,00H,00H,7FH,08H,08H,08H,08H,08H,08H,08H
U   41H,41H,22H,1CH,00H,00H,00H,00H,41H,41H,41H,41H,41H,41H,41H,41H
V   14H,14H,08H,08H,00H,00H,00H,00H,41H,41H,41H,41H,41H,22H,22H,22H
W   55H,55H,22H,22H,00H,00H,00H,00H,41H,41H,41H,41H,41H,49H,49H,49H
X   22H,22H,41H,41H,00H,00H,00H,00H,41H,41H,22H,22H,14H,08H,08H,14H
Y   08H,08H,08H,08H,00H,00H,00H,00H,41H,41H,41H,22H,22H,14H,14H,08H
Z   04H,04H,02H,7FH,00H,00H,00H,00H,7FH,40H,20H,20H,10H,10H,08H,08H
[   08H,08H,08H,08H,78H,00H,00H,00H,78H,08H,08H,08H,08H,08H,08H,08H
\   10H,20H,20H,40H,40H,00H,00H,00H,01H,02H,02H,04H,04H,08H,08H,10H
]   08H,08H,08H,08H,0FH,00H,00H,00H,0FH,08H,08H,08H,08H,08H,08H,08H
^   00H,00H,00H,00H,00H,00H,00H,08H,14H,22H,41H,00H,00H,00H,00H
_   00H,00H,00H,00H,00H,0FFH,00H,00H,00H,00H,00H,00H,00H,00H,00H,00H
`   00H,00H,00H,00H,00H,00H,00H,00H,18H,18H,08H,10H,20H,00H,00H,00H
a   42H,42H,42H,0BCH,00H,00H,00H,00H,00H,00H,00H,3CH,42H,40H,7CH,42H
b   42H,42H,22H,1EH,00H,00H,00H,00H,02H,02H,02H,1EH,22H,42H,42H,42H
c   02H,02H,44H,38H,00H,00H,00H,00H,00H,00H,00H,38H,44H,02H,02H,02H
d   42H,42H,44H,78H,00H,00H,00H,00H,40H,40H,40H,78H,44H,42H,42H,42H
e   01H,41H,22H,1CH,00H,00H,00H,00H,00H,00H,00H,1CH,22H,41H,41H,7FH
f   08H,08H,08H,08H,00H,00H,00H,00H,30H,08H,08H,08H,3EH,08H,08H,08H
g   42H,64H,58H,40H,40H,44H,38H,00H,00H,00H,00H,58H,24H,42H,42H,42H
h   42H,42H,42H,42H,00H,00H,00H,00H,02H,02H,02H,3AH,46H,42H,42H,42H
i   08H,08H,08H,08H,00H,00H,00H,00H,08H,08H,00H,08H,08H,08H,08H,08H
j   10H,10H,10H,10H,10H,0CH,00H,00H,10H,10H,00H,10H,10H,10H,10H,10H
k   0AH,12H,22H,42H,00H,00H,00H,00H,02H,02H,02H,42H,22H,12H,0AH,06H
l   08H,08H,08H,08H,00H,00H,00H,00H,08H,08H,08H,08H,08H,08H,08H,08H
m   49H,49H,49H,49H,00H,00H,00H,00H,00H,00H,00H,36H,49H,49H,49H,49H
n   42H,42H,42H,42H,00H,00H,00H,00H,00H,00H,00H,3AH,46H,42H,42H,42H
o   41H,41H,22H,1CH,00H,00H,00H,00H,00H,00H,00H,1CH,22H,41H,41H,41H
p   42H,42H,26H,1AH,02H,02H,02H,00H,00H,00H,00H,1AH,26H,42H,42H,42H
q   42H,42H,64H,58H,40H,40H,40H,00H,00H,00H,00H,58H,24H,42H,42H,42H
r   04H,04H,04H,04H,00H,00H,00H,00H,00H,00H,00H,74H,0CH,04H,04H,04H
s   40H,40H,42H,3CH,00H,00H,00H,00H,00H,00H,00H,3CH,42H,02H,0CH,30H
t   08H,08H,08H,30H,00H,00H,00H,00H,08H,08H,08H,3EH,08H,08H,08H,08H
u   42H,42H,42H,0BCH,00H,00H,00H,00H,00H,00H,00H,42H,42H,42H,42H,42H
v   14H,14H,08H,08H,00H,00H,00H,00H,00H,00H,00H,41H,41H,41H,22H,22H
w   55H,22H,22H,22H,00H,00H,00H,00H,00H,00H,00H,41H,41H,49H,49H,49H
x   24H,24H,42H,42H,00H,00H,00H,00H,00H,00H,00H,42H,42H,24H,24H,18H
y   14H,14H,08H,08H,04H,04H,02H,00H,00H,00H,00H,41H,41H,41H,22H,22H
z   04H,02H,01H,7FH,00H,00H,00H,00H,00H,00H,00H,7FH,40H,20H,10H,08H
{   0H,10H,10H,10H,60H,00H,00H,00H,60H,10H,10H,10H,10H,10H,0CH,10H
|   08H,08H,08H,08H,08H,00H,00H,00H,08H,08H,08H,08H,08H,00H,00H,00H
}   04H,04H,04H,04H,03H,00H,00H,00H,03H,04H,04H,04H,04H,04H,18H,04H
~   00H,00H,00H,00H,00H,00H,00H,00H,06H,49H,30H,00H,00H,00H,00H,00H
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