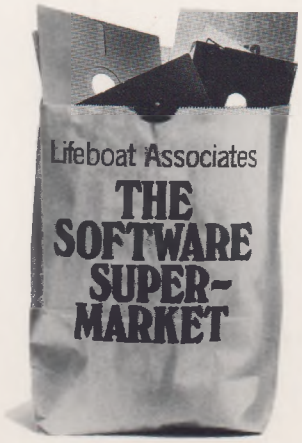
MANUAL

CP/M2 TRS-80 Model II



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CP/M2 ON TRS-80 MODEL II
USER'S NOTES

BY

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BY

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This manual was prepared on a TRS-80 Model II with CP/M, WordMaster by MicroPro International and Textwriter by Organic Software. Errors are the fault of this writer and not of these excellent tools.

Revision 2.1
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TABLE OF CONTENTS

INTRODUCTION

GENERAL INFORMATION

You have purchased one of the most useful software systems written for 8080 and Z80 microcomputers and at the same time, you have joined the largest group of disk operating system users in the world!

We at Lifeboat Associates have been very careful to supply you with the information you will need to install CP/M on a computer and to enable you to understand the system. CP/M will not be mastered without effort on your part. Read all of the manuals several times. Sit down at the keyboard and try all of the features.

If this software was purchased through a dealer, please contact the dealer for assistance in the modification and use of the system. Lifeboat Associates offers after-sales support principally through Lifelines, a monthly subscription newsletter. Also Lifeboat Associates offers a wide range of software products for use with CP/M. Refer to any catalog supplied with this manual for a listing, and regularly consult the current advertising in the various computer magazines.

WHAT IS CP/M ?

CP/M (Control Program/Microprocessors) is a software system designed to record and retrieve programs and data on floppy disks. Like all software systems, it is a collection of programs that are inter-related and are designed to accomplish specific tasks within the system. CP/M operates with 8080 and Z80 microprocessors and is largely independent of the design of the computer and floppy disk system. It has, therefore, been adopted for use with almost all computers using the 8080 and Z80 families of microprocessors. CP/M has become a de facto "standard" and a large group of high level languages and application software systems have been designed to run under its control.

Lifeboat Associates has fully installed the CP/M operating system for your TRS-80 Model II. This means that all necessary modifications to the operating system have been made specifically for the TRS-80. Computer programs running under CP/M normally "talk" only to the operating system and need no knowledge of the specific hardware in use. This is what makes programs written to run under CP/M so universal. It is because of this that such a wide variety of software can be made available so rapidly on a relatively new computer. Indeed, it is only the computer hardware that is new. The FORTRAN Compiler, Word Processing system, Data Base Manager, etc. are in fact mature and well field tested packages. You are definitely NOT being invited to test brand new and unknown software.

GETTING STARTED

YOUR CP/M PACKAGE

The contents of the CP/M package you have received from your dealer should contain the following:

a. This manual "CP/M on TRS-80 Model II User's Notes"

b. Digital Research CP/M Manuals composed of the following sections:

* CP/M 2.2 Users Guide
* An Introduction to CP/M Features and Facilities
* ED: A Context Editor For The CP/M Disk System
* CP/M Assembler (ASM) User's Guide
* CP/M Dynamic Debugging Tool (DDT) User's Guide
* CP/M 2.2 Interface Guide
* CP/M 2.2 Alteration Guide

c. An 8 inch Diskette containing your CP/M System.

d. License Agreement and Registration Cards.

ACTION: Check that you have received all of the above material. If there is anything missing, contact your dealer or Lifeboat Associates. Check that the diskette package is still sealed and in good condition. It should not be bent or damaged in any way. Every CP/M software system has a unique serial number. It is shown on your distribution copy of the diskette and the same number is embedded in the software for identification purposes. Record this number and use it when corresponding with Lifeboat Associates regarding your software. When you copy your system disk for your own use, put the copyright notice and serial number on the copy.

If your package arrived complete, sealed and in good condition, sign and mail to Lifeboat Associates and Digital Research the Registration Cards prior to opening the diskette package. Only after receipt of these cards will either Lifeboat Associates or Digital Research be able to help you in any way, in regards to the use or maintenance of this system.

BOOT PROCEDURE

This procedure should be followed to boot up your CP/M on TRS-80 Model II disk. It assumes only that your TRS-80 is functioning with 64K of RAM memory which is normally supplied. If you have a 32K model, contact Lifeboat Associates before breaking the diskette envelope seal for information on exchanging the diskette for the appropriate version.

Important note: Throughout this text and in many programs <cr> means to press the ENTER key on your keyboard. This may also be referred to in other texts as CARRIAGE RETURN or simply RETURN. Most CP/M programs require a <cr> after characters are entered from the keyboard to inform the program that operator input is complete. It is the convention of this manual that the characters to be entered into a program under discussion are printed enclosed in double quotations. Thus a section on the use of the FORMAT program in section 2d of BACKUP PROCEDURE instructs that the operator enters "A<cr>". The quotes are NOT to be typed. In this case, simply depress the A key followed by the ENTER key to perform the instructed sequence.

Step 1. Make sure there are NO diskettes in any drive.

Step 2. Turn ON the power switch. Also turn ON the power to any additional drives and printers connected to the computer. The computer should display:

INSERT DISKETTE

on the screen.

Step 3. Insert your CP/M diskette with the label facing away from the screen and gently close the diskette drive door by pushing the handle to the left.

Step 4. The diskette drive will click several times and after approximately 6 seconds the screen will display the message:

```
CP/M2 for TRS-80 Model-II
64K Version 2.xy
Copyright (C) 1979 Lifeboat Associates

A>
```

Your CP/M system is now up and running. In the version 2.xy number above, '2.x' refers to the Digital Research version and 'y"'is the Lifeboat release number.

If this is the first use of the system, refer to the next section to backup your distribution diskette. It is most important that you put your original diskette away in a safe place as soon as possible.

BACKUP PROCEDURE

This procedure must be used to make a copy of the original distribution diskette. A blank 8" diskette will first be formatted into extended density with the FORMAT program and then the original copied onto it with the COPY program.

Step 1. Boot up your CP/M diskette as previously explained.

Step 2. Format a new blank 8" diskette into extended density. This is achieved by the following sequence:

Step 2a. Type the command:

FORMAT<cr>

Result: The FORMAT program will sign-on with the message:

```
FORMAT Version x.x
For CP/M on TRS-80 II.
Copyright (C) 1980 Lifeboat Associates.

Drive number          (A B C or D) ?
```

Step 2b. Remove the original Lifeboat diskette from the drive.

Step 2c. Insert a blank 8" diskette into the drive.

Step 2d. Type the response:

A<cr>

This will tell the program to use drive A.

Step 2e. The program will now say:

```
Single , double or extended DENSITY (S, D,or X) ?
```

Step 2f. Type the response:

X<cr>

Step 2g. The program will confirm the choices with the message:

```
Press <cr> to format EXTENDED density diskette in drive A
or "E" to EXIT, "N" for NEW parameters.
```

Step 2h. Respond:

<cr>

and the diskette will now be formatted and verified for flaws, with a graphic representation of the progress displayed on the screen.

Step 2i. After FORMAT is completed, the same message as in Step 2g will be displayed. If any diskette errors were encountered by the

program, replace the diskette and again answer with a "<cr>" to re-run the program with the same parameters. Such errors may be due to either a diskette with an uncovered write protection notch or simply a diskette not up to extended density standard by reason of manufacture or mishandling. After the program has been run to conclusion without reported error, remove the newly formatted diskette, re-insert your original CP/M diskette in the drive and type the response:

E<cr>

Result: CP/M will respond with A> ready for the next command.

Step 3. If you have more than one drive, skip this step.

If you have a single drive, type the command:

ONEDRIVE<cr>

This will set your CP/M system to act as if it had four drives, (A, B, C and D) while actually using the single existing drive. You will be prompted which diskette to insert when necessary.

In this backup process, the original diskette is to be considered the A drive diskette and the newly formatted diskette is considered the B drive disk.

Step 4. Copy the original diskette onto the diskette you just formatted. To perform this function:

Step 4a.Type the command:

COPY<cr>

Result: The copy program will sign-on as follows:

```
COPY Version x.x
Copyright (C) 1980 Lifeboat Associates

Disk copy for TRS-80 Model II.
BOTH source and dest MUST be of the same density.

******   O P T I O N   T A B L E   ******
  "A"  = Copy ALL 77 tracks.
  "M"  = Copy diskette until empty (0E5H) track.
  "V"  = VERIFY the diskette by reading all data.
  "E"  = EXIT and return to CP/M.

Enter your selection from option table. -
```

Step 4b. Answer:

M<cr>

to this question and the program will respond:

```
Enter SOURCE drive name:  (A B C or D)
or <cr> makes default copy from A to B. -
```

Step 4c. Answer:

<cr>

to this question, selecting the default of copying from drive A to drive B.

Result: The program will respond:

```
Insert SOURCE in A, DESTINATION in B
  and then press <cr> to copy the disk
     or any other key to reset options. -
```

Step 4d. Now insert the diskette previously formatted into drive B if you have a two drive system.

Note: If you have a single drive, the program will prompt you to insert the newly formatted diskette in the only drive at the proper time with the message:

```
Insert B in drive, then press <cr>.
```

The program will also prompt you when to insert the original (A) diskette.

Step 4e. Enter:

<cr>

to start the copy process.

The copy diskette action will begin:

```
Copy in progress - Press ESC to abort.
Each * is a track copied and verified.
********************
```

With the single drive option selected in step 3 above, the stars will be somewhat broken up by the requests to insert alternate diskettes. Be sure to remember that the original diskette is the one requested as A and the newly formatted diskette is B.

Step 4f. Action of the copy process is as follows. The program will copy several tracks from the A drive into memory, then either switch to the B drive or prompt you to insert the newly formatted (B) diskette into the drive. It will then write and verify the same number of tracks onto the new disk. It will then either switch back to the A drive or prompt you to insert the original (A) diskette into the drive. The process will then repeat for two more cycles after which the message will be displayed:

```
Copy complete - NO errors were detected.
```

The actual number of tracks read or written per cycle reflects the amount of data per track and the amount of memory available for the copy program in the computer's memory, usually referred to as RAM. When you get further into the options, you may elect to use less than the full 64K of memory for CP/M. In that event, the program will adjust to transfer a smaller amount of diskette data per read and write cycle.

Step 4g. The program will then return to the OPTION TABLE at which time you may exit from the copy program by typing:

E<cr>

Result: The system will then return to A> ready for the next command. This completes the backup procedure.

Step 5. Now put the original diskette away in a safe place where it will be available as a fresh backup if necessary. It is important to NEVER write on the original diskette so you can always use it as a known starting point. Note that your original diskette will be regarded as proof of ownership in the event of any request for support or exchange for a later release.

DEFINITIONS OF CP/M PROGRAMS

MOVCPM.COM

This program permits the user to reconfigure the system for any particular memory size. CP/M on TRS-80 Model II is supplied with the maximum size 64k system.

Should you wish to make a smaller size system for any reason simply type, for example:

MOVCPM 32<cr>

where the example is for a system which will use only the lower 32K of memory in the computer. This allows the remainder to be reserved for some other purpose. The program will create a new 32K CP/M system and on exiting, leave it in memory at 900 hex. This may be followed by either saving the new system as a file with the SAVE command (the program will give the correct syntax for this option), or SYSGEN.COM may be used to write the system code onto the reserved system tracks of any formatted double density diskette.

The one major difference between the description given in the reference below and the supplied program is that the program will not automatically install and execute a newly generated system if an "ASTERIX" character is omitted after the size parameter. This feature was removed since its use creates an instable system which will catastrophically fail after the subsequent execution of the majority of CP/M programs.

Reference:"AN INTRODUCTION TO CP/M FEATURES AND FACILITIES", Section 6.9, Page 30.

ASM.COM

This program is an 8080 disk oriented two-pass assembler.

Reference: "AN INTRODUCTION TO CP/M FEATURES AND FACILITIES", Section 6.2, Page 16 and "CP/M ASSEMBLER (ASM) USER'S GUIDE".

DDT.COM

This program is the CP/M Dynamic Debugging Tool which combines a powerful monitor with a tool for analyzing software problems. It can perform common monitor program functions such as dumping memory in HEX and ASCII. It can also disassemble 8080 machine code into assembly language mnemonics or assemble individual instructions directly into memory.

Reference: "CP/M DYNAMIC DEBUGGING TOOL USER'S GUIDE".

ED.COM

This program is the CP/M text editor. It permits creation and alteration of text files in ASCII under CP/M such as the source programs for high-level languages such as BASIC and FORTRAN.

Reference: "AN INTRODUCTION TO CP/M FEATURES AND FACILITIES", Section 6.5, Page 25, "ED: A CONTEXT EDITOR FOR THE CP/M DISK SYSTEM - USER'S MANUAL", and "CP/M 2.2 USER'S GUIDE", Section 6, Page 10.

LOAD.COM

This program reads a disk file of HEX machine code such as produced as output by the assembler and creates a .COM file of the same name.

Reference: "AN INTRODUCTION TO CP/M FEATURES AND FACILITIES" Section 6.3, Page 17.

PIP.COM

This is the Peripheral Interchange Program which is used to transfer files from disk to disk. It also does such things as media conversion necessary to print, punch, copy and combine disk files. Study the uses and forms of the PIP.COM program very carefully as this powerful program will be frequently used. When PIP.COM is used on a single drive system, CP/M will prompt you to swap diskettes at the proper time to simulate multiple drives.

Reference: "AN INTRODUCTION TO CP/M FEATURES AND FACILITIES", Section 6.4, Page 18 and "CP/M 2.2 USER'S GUIDE", Section 5, Page 8.

STAT.COM

This program reports information about disk capacity, file sizes, file indicators and device assignments. The program can also be used to manipulate the file indicators and device assignments.

Reference: "AN INTRODUCTION TO CP/M FEATURES AND FACILITIES", Section 6.1, Page 13 and "CP/M 2.2 USER'S GUIDE", Section 4, Page 5.

SUBMIT.COM

This program allows CP/M commands and program input lines to be "batched" together for automatic processing.

Reference: "AN INTRODUCTION TO CP/M FEATURES AND FACILITIES", Section 6.7, Page 28.

XSUB.COM

This program permits the SUBMIT.COM program to pass to batched programs the input lines that the operator would have supplied in the non-batch use of that program.

Reference: "CP/M 2.2 USER'S GUIDE", Section 7, Page 11.

SYSGEN.COM

This program allows the CP/M operating system to be read from and written to the system tracks of EXTENDED density diskettes, or to be loaded from an EXTENDED density diskette into memory for alteration.

Only a system diskette, i.e. one with a CP/M system written on the reserved system tracks, may be used in drive A to COLD BOOT the system. Since the tracks are reserved, and so not otherwise available for programs or files, it is usual to place a system onto most diskettes in use. A system diskette has no less data storage capacity than a non-system diskette. Under no circumstances should a system be on a diskette used to send programs to another computer user. First, it is in violation of the license agreement, and worse, the serial number difference may cause certain programs to malfunction.

SYSGEN.COM uses memory at 900 hex as the location of a buffer for the system code. A copy of the system in the buffer is called a "sysgen image" and is always at 900 hex. Note that CP/M never executes at this address. This is simply a convenient location for examination and modification of the code. It is also the exact same location as the new system image that is created by execution of the MOVCPM.COM program. This is why SYSGEN.COM can be used to write a system from memory onto the system tracks of a diskette immediately after execution of the MOVCPM.COM utility.

A system diskette MUST be formatted in EXTENDED density in order to permit the SYSGEN.COM utility to write the operating system to the system tracks.

Reference: "AN INTRODUCTION TO CP/M FEATURES AND FACILITIES", Section 6.6, Page 27.

DUMP.ASM

This is a sample assembly language source file which exemplifies how CP/M programs may be written in assembly language.

Reference: "CP/M 2.2 INTERFACE GUIDE", Page 34 and "AN INTRODUCTION TO CP/M FEATURES AND FACILITIES", Section 6.8, Page 30

DUMP.COM

The assembled and loaded program from DUMP.ASM, above.

Reference: As DUMP.ASM above.

FORMAT.COM

This program will format a new diskette for single, double and extended density. Extended density is the name given by Lifeboat Associates to the format chosen for their implementation of CP/M on the TRS-80 Model II. It is used to distinguish it from the TRSDOS format of double density. Actually the recording density of the data is no greater than double density, but the format offers about 20% more storage through a choice of a different IBM scheme which wastes less of the diskette track with the inter-record guard gaps. This is achieved by using 8 sectors of 1024 data bytes instead of 26 sectors of 256 data bytes. In TRSDOS, a further dis-economy results from the discarding of the 26th sector in order to maintain a track as a group of five TRSDOS granules. It must be emphasized that the increased storage offered by the Lifeboat Associates' format does not create any requirement for better quality diskettes or demand any higher performance from the equipment than the designed specification for the TRSDOS format.

To initiate the program, enter on the keyboard:

FORMAT<cr>

The program offers a menu of options and provides prompts to the alternatives at each stage of operation

The ability to format in single and double density is included in order to create diskettes intended for program exchange with other CP/M computers and as a TRSDOS aid respectively.

COPY.COM

This is a diskette copying program to copy data from one diskette to another. This program copies the entire disk using the "A" (ALL) option or to save the time of copying unused portions of a diskette, the "M" (Most) option which copies only until the program detects an empty track. The "V" (Verify) option checks a disk for proper format by reading all sectors and reporting errors if any. COPY will prompt you at each step on exactly what to do and may be used on a single drive system.

To start the program, type the command:

COPY<cr>

The program offers a menu of options, and prompts for use both with multiple or a single disk drive.

Note that the COPY.COM utility will automatically copy a CP/M extended density diskette, a CP/M single density diskette and a TRSDOS double density diskette. The only requirement is that the diskette to receive the copy is already formatted in the same density as the diskette to be copied. The program will notify the operator if mis-matched density diskettes are present. When copying a TRSDOS diskette ALWAYS use the "A" (ALL) option since TRSDOS leaves unused tracks before the diskette is filled, and the detection of such a track will prematurely terminate the copy.

FILECOPY.COM

This program will transfer files between disks using only a single disk drive. It loads as much as possible of a single file from the source disk into memory, instructs the user to change disks, and writes the file onto the new disk. With files larger than the available memory, the program will continue to prompt until complete. The program will correctly transfer between any mixture of CP/M single and extended density diskettes.

To transfer TEST.HEX from one diskette to another, enter:

FILECOPY TEST.HEX<cr>

and the program will prompt which disks to insert at the proper time.

CONFIG.COM

This program displays the status of the CP/M system and allows changes in selecting serial or parallel ports, baud rates, startup commands, disk seek rates and parallel printer formats. Start the program with the command:

CONFIG<cr>

It is menu driven and designed to be used in an interactive fashion. The first and possibly only use for this utility with most users is the installation of the system PRINTER, called the LIST device by CP/M convention. By using CONFIG.COM to install the printer onto one of the serial ports, at the correct baud rate (speed) and with the correct communications protocol or onto the parallel port, applications will automatically output to your peripheral without the author of the program ever needing to know the type of printer you have selected.

USER.ASM

This is a sample skeletal portion of the BIOS which may be used by experienced programmers as the basis for writing their own alternative code to perform I/O to the console printer and other peripherals. The listing is included in this manual as Appendix B.

The full source code for that section of the BIOS which includes the

drivers for the keyboard, screen, parallel and serial ports is available as a separate product to licensed users of Lifeboat Associates' CP/M.

MEMR.COM

This program is a memory test program that performs a battery of different tests. Start the program with the command:

MEMR<cr>

The test will cycle continously and report to the screen the location of any errors found.

ONEDRIVE.COM

This program will temporarily convert your single drive CP/M system on the original distribution diskette into a simulated multiple drive system for the purpose of backing up the original. It does this by prompting the user to switch diskettes at the proper time. Run the program by typing the command:

ONEDRIVE<cr>

The CONFIG.COM program accomplishes the same function in a more permanent manner since its use will cause the system to start up in the correct mode each time. The pricipal use for the utility is to perform the backup procedure the first time with a single drive system.

Both ONEDRIVE.COM and CONFIG.COM permit the diskettes, mounted as logical drives B, C and D, to be single density, in order to aid correspondence with users of CP/M supplied with other computer systems. In general, single density correspondence is recommended since no universal standard for other formats has been adopted. Lifeboat Associates will make the distribution of all software products, other than the CP/M system itself, in single density. The code number of this format is A1, and should be used when obtaining compatible software products, such as a BASIC interpreter or word-processing system

VIDTEST programs

Several programs are provided to demonstrate the Video cursor control codes of the screen driver. These are VIDTEST.ASM, VIDTEST.COM and VIDTEST.BAS. The demonstration sequence used in these programs is described in the section 'Features Implemented' which follows this section defining the programs supplied.

TOF.COM

This program will inform the computer, when using the parallel port forms-control feature, that the operator has manually moved the printer paper and that now the printer is at the head of a form. This is most useful after the operator has manually advanced the paper in order to remove a printed page or has re-loaded the printer with a form of a different type. The program is executed by issuing the command:

TOF<cr>

at which point the program will ask for a confirming "T". Entering any other character will abort the procedure.

GETFILE.COM

This program is designed to transfer files from TRSDOS to CP/M and is initiated with the command:

GETFILE<cr>

The program offers operation instruction through detailed prompting. A BASIC program to be transfered should be saved under TRSDOS with the "-A" option switch set so that the file is in full ASCII. This permits the GETFILE.COM program to replace TRSDOS line-feed line termination characters with the carriage-return/line-feed sequence required by CP/M programs. GETFILE.COM will only make such substitutions when requested by the user at the appropriate prompt. Other ASCII files, such as source programs for FORTRAN or COBOL, should also have this conversion made during the transfer.

DUMBTERM.COM

This utility allows the computer to be used as a terminal to another computer directly by wire or via a modem telephone connection. In this mode the computer will behave like an ADM-3A because of the screen driver software installed. This program is not intended to permit transfer of data from the other computer to the TRS-80 diskette. It is only intended to permit the keyboard and screen to be used just as a regular terminal. The program is invoked through the command:

DUMBTERM<cr>

The program will then request which serial port is to be used. A faster method of initiating is to issue the command:

DUMBTERM A<cr>

which will command the A serial port to be used. The letter B can be used to commence the program to the other port. To exit for the DUMBTERM mode, depress the HOLD key twice.

Note that the program will use the serial ports in the manner programmed by the CONFIG setting. Use CONFIG.COM to program the baud rate (speed) setting and the communications protocol. A setting of 'No Communications Protocol' will be the correct setting to fully emulate the LSI ADM-3A terminal.

DUMBTERM.ASM

This is the source code of the DUMBTERM.COM program. It can be modified in order to change the program's behavior, or examined for a better understanding of the direct use of the serial ports of the computer.

CORVINIT.COM

A program which is supplied with the version of CP/M Version 2.2x-C for use with a Corvus winchester disk. This program clears the directory space of the winchester prior to first use. Refer to the Appendix A covering the use of CP/M with a Corvus disk attached to the TRS-80 Model II

READ-ME.DOC

This file, if present on the disk, will be used to communicate errors, omissions, additions and changes to the manual description of the software. It is recommended that soon after acquiring the system, you enter the command:

TYPE READ-ME.DOC<cr>

to find any changes to this software system made subsequently to the printing of this edition of the manual. Use the 'Control S' key to stop and start the screen scrolling, if the material moves too fast by the screen.

FEATURES IMPLEMENTED

The CP/M on TRS-80 Model II system is delivered fully installed for the computer peripherals.

VIDEO DRIVER

The following features are implemented: The screen driver is designed to emulate the popular ADM-3A (*) Dumb Terminal supplied by the Data Products Division of Lear Siegler, Inc.

In addition, access to the TRS-80 graphics characters is available by preceding a control character with an ESCape character. The characters corresponding to the value defined in the appendix to the TRS-80 Owner's Manual as decimal 128 through 159 are accessed at decimal 0 through 31 (control @ through control _) preceded by a single ESCape. Thus, character 09H will normally be expanded into a TAB, but if preceded with the ESCape, the character will be displayed as the member of the graphic character set defined under TRSDOS as decimal 137.

The reverse video of a character is available by adding 128 (80 HEX) to the character value. This facility includes the reverse of the graphic characters.

The screen command codes supported are:

Function	HEX	Decimal
Line Feed	0AH	10
Reverse Line Feed	0BH	11
Non-Destructive Forward Space	0CH	12
Carriage Return	0DH	13
Clear Screen	1AH	26
Home Cursor	1EH	30

The cursor addressing command is a sequence initiated by the two characters "ESC" and "=", which are 1BH and 3DH respectively in HEX or 27 and 61 in decimal, followed by the address of the desired cursor position encoded in two digits in the form:

Row Number + 20H, Column Number + 20H (in Hex) or
Row Number + 32, Column Number + 32 (in decimal)

This convention numbers the Rows from 0 through 23 and Columns 0 through 79 (both in decimal).

By way of example of addressing and graphics, the sequence:

---

*) Dumb Terminal is a registered trademark of Lear Siegler, Inc.

1E,1A,1B,1E,E1,1B,3D,37,6D,1B,9F,41,8,8,8 IN HEX

30,26,27,30,225,27,61,55,109,27,159,65,8,8,8 in decimal

will perform the following:

Home cursor, clear screen, display the largest graphic character followed by a lower-case "a" in inverse video, move the cursor to near the lower right corner, and display the last graphic character (an up-arrow) in reverse video followed by an upper-case "A". At the end, the cursor is backed-up three spaces.

A file VIDTEST.BAS, supplied on this distribution diskette will operate under both CBASIC version 2.05 or later and Microsoft BASIC-80 to perform the described sequence to aid BASIC programmers.

Another set of files: VIDTEST.ASM and VIDTEST.COM perform the sequence in assembly language. To run the test simply type the command:

VIDTEST<cr>

The program is written entirely in 8080 compatible code, permitting its re-assembly using the supplied ASM.COM utility.

Both the BASIC and assembly language demonstration programs are written to hang up at their termination in order to keep the intended image from scrolling off the screen.

The VIDEO memory bank at 0F800H is normally enabled permitting applications to directly write characters to the screen. Note that in a 64K system, as distributed or as can be created from the MOVCPM utility, all of the Read/Write memory is used. The main memory at the address of the video bank is used for disk buffers. If memory is needed for a non-CP/M purpose, use the MOVCPM utility to create a smaller system. Note that the memory made available is that starting BELOW 0F800H. Say a system is generated with the command:

MOVCPM 62<cr>

and then this new system is placed onto the system tracks of a DOUBLE or EXTENDED density diskette with SYSGEN, then the user will have created free space between 0F000H and 0F7FFH (i.e. 2K) which will be available for non-CP/M use.

DISK DRIVERS

Both TRSDOS density and an Extended density are supported. The Extended format diskette can contain up to 596K bytes of data in addition to system and directory information.

In the system, any of the three densities of format, Single, Double and Extended density, may be mixed on different drives during the execution of a program. It is not necessary for the operator to

inform the system, or even be aware of the diskette densities, excepting, however, that a system diskette should generally be on drive A, and a system can only be accommodated on an Extended density diskette.

The format program supplied will create any of the three formats required. The Double density can be used as a CP/M non-system diskette, but is not recommended. If used, it is format and directory compatible with certain versions of CP/M distributed for the Thinker Toys Discus 2D and the iCOM 3812 disk systems, and with releases of Lifeboat Associates' CP/M prior to 2.20. Double density is also format compatible (NOT directory compatible) with TRSDOS disks so that the FORMAT and COPY utilities can serve as faster alternatives to the TRSDOS BACKUP procedure.

Although the disk drivers are designed to automatically recognize which of the permitted formats of diskette is mounted onto a drive, this automatic selection is only performed on the FIRST access after a warm or cold boot. If a change is made without such a boot, an error message will be issued. Typing a <Control C> is not always necessary since most programs automatically end with a WARM BOOT.

Systems programmers may care to note that selecting a drive with the highest bit set will cause the drive to be re-mounted, forcing the disk drivers and BDOS to re-evaluate the format density of the diskette, thereby permitting any necessary diskette changes to be made during the execution of a program.

The disk drive code will permit slow drives to be used and also those configured to step at Head Load instead of the more conventional Drive Select. The speed of the stepping is chosen through use of the CONFIG utility.

SERIAL PORT PROTOCOLS

The serial ports are provided with four optional communication modes: a) Hardware handshaking b) ETX/ACK protocol c) DC1/DC3 protocol and d) No handshaking. The CONFIG utility is used to select the mode required. The distribution default is with hardware handshaking. These protocols permit transmitting data at high speed to devices which are able to print at a slower speed. Characters will not be lost either through a slow speed printer, or if the printer gets into difficulty such as detecting 'out of paper' or 'end of ribbon' alarms.

When installing a printer or other serial output peripheral, remember that the TRS-80 has been wired at its connectors using the DATA TERMINAL convention, even though it has socket connectors which EIA denotes the DATA SET should have. The implication is that, in general, it will be necessary to interchange the leads to pins 2 and 3 when inter-connecting to a peripheral, since most output peripherals are configured as DATA TERMINAL equipment and are intended to be wired directly to a DATA SET, not to another DATA TERMINAL.

Hardware Handshaking

Hardware handshaking involves the computer monitoring two of the connections to the DB-25S socket connectors on the TRS-80. The receiver of a TRS-80 port is enabled with pin 8 (DCD) high, and the transmitter with pin 5 (RTS) high. The computer itself will generate a high on pin 20 (DTR) when it is able to receive a character, and so this can be used to control a device transmitting to a TRS-80 port receiver.

ETX/ACK Protocol

ETX/ACK protocol involves the TRS-80 blocking the output into 'messages' of fixed length. At the end of each message (actually after each 127 characters), the computer inserts an ETX (End of Text, also known as control C) character and then waits. The receiving device, say a buffered printer such as a Diablo 1640, will print each character until it comes upon the ETX, when it will transmit back to the TRS-80 an ACK (Acknowledge / control F) character which revives the transmission.

DC1/DC3 or XON/XOFF Protocol

DC1/DC3 protocol involves the TRS-80 monitoring the input data line while transmitting. The receiving device, such as a Texas Instruments 800 series printer, will receive characters into its buffer at the transmitted data rate of say 9600 baud while printing out at say 120 cps, or around 1200 baud. When the printer senses that its input buffer is more than perhaps 50% full, it transmits a DC3 (Device Control 3 / control S) character, which the TRS-80 detects and acts upon by suspending transmission. The printer will later detect that it has sufficiently emptied its buffer onto paper and will generate a DC1 (Device Control 1 / control Q) character to revive the TRS-80. Note that DC1/DC3 are also know as XON/XOFF (punch on/punch off) from the usage on the veteran ASR33 Teletypes.

Refer to the hardware manual of the printer or any other communications device be used to determine which protocols are required.

PARALLEL PORT PRINTER FORMS CONTROL

The software driver for any printer connected to the parallel port has a forms control driver included which will automatically generate spacing over the page breaks and expands TAB characters to horizontal spaces with tabulation set at modulus 8 spaces. This permits a Centronics or Radio Shack Line Printer III printer to be used with standard software designed for use with a printer having more features.

The page format is controlled in the CONFIG.COM utility. If an application program is already controlling the page format, set the printable lines per page equal to the length of the form (typically

66 each for 11 inch paper and a typical 6 lines per inch. This will prevent extra space to be left at a page break, but still permit handling of the Form-Feed and TAB characters.

If a smart printer able to correctly handle horizontal TABultation from transmitted TAB characters, form eject from transmitted Form-Feed characters and back-spacing, then set the printable lines per page to zero. This special setting will allow the printer to use its built-in features. .

any accesses to the floppy drives while in the CORVUS environment.

2) The built-in floppy disk drive and any other installed drive may be mounted with a diskette of any of the three supported densities either for operation and reference in a program, for down-loading software for correspondence to other users or as back-up.

APPENDIX B - USER AREA LISTING

```
                ;
                ;
                ;USER            JAN 10, 1980
000A =          VERS    EQU     10
                ;
                ;Provided by LIFEBOAT ASSOCIATES
                ;
                ;CP/M Version 2 USER AREA for TRS-80 Model II.
                ;This file contains the proper equates
                ;to be used by you as a basis
                ;for installing your own I/O routines.
                ;
                ;*****************************************
                ;;;     CP/M EQUATES FOR VERS 2.0
                ;*****************************************
0040 =          MSIZE   EQU     64              ;CP/M SYSTEM SIZE
A700 =          BIAS    EQU     (MSIZE-20)*1024-900H
DB00 =          CCP     EQU     3400H+BIAS      ;BASE OF CCP
E300 =          BDOS    EQU     CCP+800H        ;BASE OF BDOS
F100 =          BIOS    EQU     CCP+1600H       ;BASE OF BIOS
F200 =          USER    EQU     BIOS+100H       ;BASE OF USER AREA
2F00 =          OFFSET  EQU     0A00H-CCP       ;TO SYSGEN IMAGE
0003 =          IOBYT   EQU     3               ;INTEL I/O BYTE
                ;
                ;VECTOR TO INTERNAL ROUTINES NOT TO BE CHANGED.
0000 =          INTX    EQU     0               ;NOT THE REAL ADDR
                ;
                ;*********************************************
                ;;;DISK STRUCTURE AND SYSGEN IMAGE FROM 900H TO 30FFH
                ;*********************************************
                ;
                ;       TRACK   SECTOR  SYSGEN  64K
                ;BOOT   0       5,13    0900H   0DA00H
                ;CCP    1       1       0A00H   0DB00H
                ;BDOS   1       17      1200H   0E300H
                ;MSG    1       16      1180H   0E280H
                ;BIOS   0       1       2000H   0F100H
                ;MODE   0       2       2080H   0F200H
                ;USER   0       3       2100H   0F300H
                ;HSTBUF -       -       -       0FD00H
                ;DATA   -       -       -       0FE00H
                ;
```

```
                ;*****************************************
                ;;;     BIOS BEGINS HERE
                ;*****************************************
                ;
F100                    ORG     BIOS
                        ;STANDARD CP/M JUMP TABLE
F100 C30000     CBOTE   JMP     INTX            ;COLD BOOT ENTRY
F103 C30000     WBOTE   JMP     INTX            ;WARM BOOT ENTRY
F106 C306F2     CONST   JMP     VCONST          ;CONSOLE STATUS
F109 C30000     CONIN   JMP     INTX            ;CONSOLE INPUT
F10C C30000     CONOUT  JMP     INTX            ;CONSOLE OUPUT
F10F C30FF2     LIST    JMP     VLIST           ;PRINTER OUTPUT
F112 C312F2     PUNCH   JMP     VPUNCH          ;PUNCH OUTPUT
F115 C315F2     READER  JMP     VREADER         ;READER INPUT
F118 C30000     HOME    JMP     INTX            ;SEEK TRACK 0
F11B C30000     SELDSK  JMP     INTX            ;SELECT DISK
F11E C30000     SETTRK  JMP     INTX            ;SET TRACK
F121 C30000     SETSEC  JMP     INTX            ;SET SECTOR
F124 C30000     SETDMA  JMP     INTX            ;SET DMA ADDRESS
F127 C30000     READ    JMP     INTX            ;DISK READ
F12A C30000     WRITE   JMP     INTX            ;DISK WRITE
F12D C318F2     LISTST  JMP     VLISTST         ;PRINTER STATUS
F130 C30000     SECTRAN JMP     INTX            ;SECTOR TRANSLATION
                ;
                ;*****************************************
                ;;;     TRANSLATE TABLES
                ;*****************************************
                ;
                ;Single density translate table (128 byte sectors).
F133 01070D13           DB      1,7,13,19
F137 19050B11           DB      25,5,11,17
F13B 1703090F           DB      23,3,9,15
F13F 1502080E           DB      21,2,8,14
F143 141A060C           DB      20,26,6,12
F147 1218040A           DB      18,24,4,10
F14B 1016               DB      16,22
F14D 01                 DB      1               ;END OF TABLE
                ;
                ;Double density translate table (256 byte sectors).
F14E 0102131425         DB      1,2,19,20,37,38
F154 0304151627         DB      3,4,21,22,39,40
F15A 0506171829         DB      5,6,23,24,41,42
F160 0708191A2B         DB      7,8,25,26,43,44
F166 090A1B1C2D         DB      9,10,27,28,45,46
F16C 0B0C1D1E2F         DB      11,12,29,30,47,48
F172 0D0E1F2031         DB      13,14,31,32,49,50
F178 0F10212233         DB      15,16,33,34,51,52
F17E 11122324           DB      17,18,35,36
F182 01                 DB      1               ;END OF TABLE
                ;
F183                    DS      BIOS+100H-$     ;INTERNAL CODE
                ;
```

```
                ;***********************************************
                ;;;     USER I/O AREA
                ;***********************************************
                ;
F200                    ORG     USER
                ;       USER AREA JUMP TABLE
                ;
                ;Modify the code in this area ONLY.
                ;These jumps MUST remain here in the order given.
                ;You MAY modify the ADDRESSES for your own routines.
                ;
F200 C31BF2     VCINIT  JMP     UCINIT          ;COLD BOOT INIT
F203 C321F2     VWINIT  JMP     UWINIT          ;WARM BOOT INIT
F206 C322F2     VCONST  JMP     UCONST          ;CONSOLE STATUS
F209 C323F2     VCONIN  JMP     UCONIN          ;CONSOLE INPUT
F20C C326F2     VCONOUT JMP     UCONOUT         ;CONSOLE OUTPUT
F20F C327F2     VLIST   JMP     ULIST           ;LIST OUTPUT
F212 C329F2     VPUNCH  JMP     UPUNCH          ;PUNCH OUTPUT
F215 C32AF2     VREADER JMP     UREADER         ;READER INPUT
F218 C328F2     VLISTST JMP     ULISTST         ;LIST STATUS
                ;
                UCINIT:
                        ;COLD INITIALIZATION
F21B 3E80               MVI     A,80H   ;INITIAL IOBYT
                        ;80H ASSIGNS LST:=LPT: (PIO PARALLEL PRINTER)
F21D 320300             STA     IOBYT   ;STORE IT AT LOC 3
                        ;CALL YOUR OWN INITIALIZATION HERE
F220 C9                 RET
                ;
                UWINIT:
                        ;WARM INIT. CODE CAN GO HERE
F221 C9                 RET
                ;
                UCONST:
                        ;CONSOLE STATUS ROUTINE
                        ;RET 0 IN ACC IF NO CHAR TYPED ON CONSOLE
                        ;RET 0FFH IN ACC IF CHAR TYPED
F222 C9                 RET
                ;
                UCONIN:
                        ;CONSOLE INPUT ROUTINE
                        ;INPUT CHARACTER TO ACCUMULATOR.
F223 E67F               ANI     7FH     ;STRIP PARITY
F225 C9                 RET
                ;
                UCONOUT:
                        ;CONSOLE OUTPUT ROUTINE
                        ;OUTPUT CHARACTER FROM REG C.
F226 C9                 RET
                ;
                ULIST:
                        ;LIST (PRINTER DEVICE) OUTPUT ROUTINE
                        ;OUTPUT CHARACTER FROM REG C.
F227 C9                 RET
                ;
                ULISTST:
```

```
                        ;LIST STATUS ROUTINE
                        ;RET 0 IN ACC IF PRINTER NOT READY TO OUTPUT
                        ;RET 0FFH IN ACC IF READY
F228 C9                 RET
                ;
                UPUNCH:
                        ;PUNCH OUTPUT ROUTINE
                        ;OUTPUT CHARACTER IN REG C TO PUNCH.
F229 C9                 RET
                ;
                UREADER:
                        ;READER INPUT ROUTINE
                        ;INPUT CHAR FROM READER DEVICE INTO ACC.
F22A E67F               ANI     7FH     ;STRIP PARITY
F22C C9                 RET
                ;
                        ;THERE IS ROOM FOR 5 PAGES (5*256 BYTES)
                        ;OF USER CODE IN THIS AREA.
                ;
F22D                    DS      BIOS+600H-$
                ;
                ;***********************************************
                ;;;     DISK DRIVER AREA
                ;***********************************************
                ;
                ;THE INTX FUNCTIONS JUMPED TO FROM THE
                ;BIOS JUMP TABLE ABOVE ARE SPECIALLY HANDLED
                ;IN THIS AREA.
                ;
                ;ESPECIALLY NOTE THAT CONIN AND CONOUT FIRST
                ;MUST BE HANDLED IN THIS AREA BEFORE JUMPING
                ;INTO THE USER I/O AREA WHERE YOU MAY MODIFY
                ;OR INSTALL YOUR OWN ROUTINES.
                ;
F700                    DS      BIOS+12*100H-$
                ;
                ;***********************************************
                ;;;     DATA AREA
                ;***********************************************
FD00            HSTBUF: DS      256             ;DISK BUFFER
FE00                    DS      512             ;MISC DATA
0000                    END
```

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