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Dresdner Bank
Konto-Nr. 9 009 863

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GfG: W.B.MELZER
Tel.: (0 22 03) 5 30 94
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COMPUPAK OVERVIEW

Release A-4

12/01/80

The CompuPak System provides data processing capabilities to the CPT 8000 user. This is done by providing an interface which allows the CPT 8000 to act as a data processing terminal in support of the CP/M operating system produced by Digital Research Corporation. This operating system has become widely used because of its flexibility. The Release A series of CompuPak utilizes CP/M version 1.4 with 48k bytes of memory. Release B will be based on CP/M version 2.1, and will also utilize 48k bytes of memory.

CompuPak requires two disks. The first disk is called the CompuPak Interface disk. It loads as a program disk on a CPT 8000 and makes a large data processing screen available. It also asks the user to insert a CP/M disk into station A, and provides an opportunity for the user to copy CPT Word Processing filing disk pages to or from CP/M files. When this work is complete, the CP/M disk in station A takes charge of the system and makes it into a standard CP/M system. The first CompuPak interface disk contains programs that were written by CPT Corporation. The second CP/M disk contains the CP/M operating system. This disk bears the registered serial number from Digital Research Corporation and must match the serial number provided on the CPT CompuPak Interface disk. If the numbers do not match the second disk will not work and the user will see a message indicating that the interface has been terminated. (Note: These serial numbers are on the disk itself, not on the label that is on the cover of the disk.)

The CompuPak Interface disk contains the programs which control the peripherals attached to the CPT 8000. These programs control the display screen, printers, keyboard, and disk drives. How certain control characters affect these devices is discussed in the system implementation portion of this document. No CPT software currently exists to support a reader device or punch device although CP/M will support these devices.

The CompuPak CP/M disk contains the operating system and file system. This disk is not the standard CPT formatted disk. It is formatted similiar to the IBM 374X series of disk type which features 77 tracks each containing 26 sectors of 128 bytes of user data. All data processing applications packages that are available from CPT use disks that have this same format.

By pressing the CODE key together with the question mark '?' character key, the system indicates the current release level of both disks.

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COMPUPAK IMPLEMENTATION

The CompuPak Interface disk is a program disk containing the machine dependent portion of the CP/M operating system, called the Customized Basic I/O Subsystem (CBIOS). It also contains the copy utility, which acts as an interface between CP/M and Word Processing. Only the copy utility supports both CPT word processing and CP/M data processing disks at the same time. Once CP/M is in control only IBM 3741 formatted disks are allowed.

KEYBOARD DRIVER

The keyboard hardware merely assigns to each key a number, and it is up to software to convert these numbers to character codes. Below is the American Standard keyboard with the name assigned to each key.

1 2 3 4 5 6 7 8 9 0 0a 0b

Q W E R T Y U I O P Pa

A S D F G H J K L La Lb

Z X C V B N M Ma Mb Mc

The keys A through Z, when depressed in conjunction with a CODE key are termed control codes. These control codes are used by the CP/M operating system and by application packages to control devices and the handling of data. Some applications use these codes in different ways and there is no standard. The ASCII codes 1 through 26 represent CODE A through CODE Z. The CP/M operating system is designed for the standard ASCII character set and the usual data processing type terminal without many special function keys. In the CompuPak implementation of CP/M, the additional control keys such as WORD, ADJ, PRINT, ... have been assigned to control characters.

KEYBOARD TRANSLATION

Some keys may have three different assignments; a regular stroke, shifted stroke, and another interpretation when depressed along with the CODE key. Below is a table that correlates the key with the character or action that is produced. The ASCII decimal value for each character is also shown.

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Table 1 (below and on page 4) represents the main keyboard, in an unshifted state, and the two columns of control keys on either side of it. Table 2 (page 5) represents keys to the right of the main keyboard. Shifting has no effect on these keys. Table 3 (pages 6-7) represents the shifted equivalents of the entries on Table 1. Note that since shifting has no effect on control keys, their entries in the two tables are the same.

Standard Key	ASCII Decimal Value	Character Table Entry	Description
Z	122	'z'	
X	120	'x'	
C	99	'c'	
V	118	'v'	
B	98	'b'	
N	110	'n'	
M	109	'm'	
Ma	44	','	Comma
Mb	46	'.'	Period
Mc	47	'/'	Slash
A	97	'a'	
S	115	's'	
D	100	'd'	
F	102	'f'	
G	103	'g'	
H	104	'h'	
J	106	'j'	
K	107	'k'	
L	108	'l'	
La	59	';'	Semicolon
Lb	39	'	Apostrophe
Q	113	'q'	
W	119	'w'	
E	101	'e'	
R	114	'r'	
T	116	't'	
Y	121	'y'	
U	117	'u'	
I	105	'i'	
O	111	'o'	
P	112	'p'	
Pa	92	\	Back-slash
1	49	'1'	
2	50	'2'	
3	51	'3'	
4	52	'4'	
5	53	'5'	
6	54	'6'	
7	55	'7'	
8	56	'8'	
9	57	'9'	
0	48	'0'	

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0a	45	'-'	Hyphen or Minus Sign
0b	61	'='	Equal
Code			
Clear Tab Set	19		Clears or sets tabs
Hold			Capital Lock **
Mar Set	No action		
Mar Rel	26		Code Z
Code			
Insert	6		Code F
Prog	No action		
Move	9		Code I
Erase	8		Backspace
Tab	9		Code I
Lock			
Shift			
Backspace	8		Code H
Return	13		Code M
Space Bar	32	' '	Blank or Space

NOTE - The Hold key will make the letters 'a' through 'z' into capitals without making the upper row of the keyboard shift. This key is an ON/OFF action key which is defaulted to on.

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The following table represents the action that results from depressing a key found on one of the two pads on the right half of the keyboard.

Standard Key	ASCII Decimal Value	Character Table Entry	Description
Stop	3		Code C
Skip	27		Code ;
Adj	14		Code N
Up	11		Code K
Down	10		Code J
Char	7		Code G
Word	15		Code O
Line	25		Code Y
Para	18		Code R
Page	3		Code C
In	10		Code J
Out	127		Rubout
Print	16		Code P
Recover - blank key that is below the print key	12		Code L
Hat - blank key that is two below the print key	8		Code H
Numeric Pad			
0	48	'0'	
1	49	'1'	
2	50	'2'	
3	51	'3'	
4	52	'4'	
5	53	'5'	
6	54	'6'	
7	55	'7'	
8	56	'8'	
9	57	'9'	
* - blank key above the 7 key	42	'*'	
/ - blank key above the 8 key	47	'/'	
+ - blank key above the 9 key	43	'+'	
-	45	'-'	
,	44	','	
.	46	'.'	
Enter	13	CR	Carriage Return

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The following table represents the shifted state of the regular keyboard along with the two vertical banks to the immediate right and left of it. (To represent a key in its shifted state, an apostrophe is typed next to the key name. EX: A' indicates that the A key and shift key are utilized.)

Standard Key	ASCII Decimal Value	Character Table Entry	Description
Z'	90	'Z'	
X'	88	'X'	
C'	67	'C'	
V'	86	'V'	
B'	66	'B'	
N'	78	'N'	
M'	77	'M'	
Ma'	44	','	Comma
Mb'	46	'.'	Period
Mc'	63	'?'	Question Mark
A'	65	'A'	
S'	83	'S'	
D'	68	'D'	
F'	70	'F'	
G'	71	'G'	
H'	72	'H'	
J'	74	'J'	
K'	75	'K'	
L'	76	'L'	
La'	58	':'	Colon
Lb'	34	'"'	Quotation Mark
Q'	81	'Q'	
W'	87	'W'	
E'	69	'E'	
R'	82	'R'	
T'	84	'T'	
Y'	89	'Y'	
U'	85	'U'	
I'	73	'I'	
O'	79	'O'	
P'	80	'P'	
Pa'	94	'^'	Inverted v
1'	33	'!'	
2'	64	'@'	At sign
3'	35	'#'	Pound sign
4'	36	'$'	Dollar sign
5'	37	'%'	Percent sign
6'	95	'_'	Underline
7'	38	'&'	Ampersand
8'	42	'*'	Asterisk
9'	40	'('	Left parenthesis
0'	41	')'	Right parenthesis

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0a'	No action		
0b'	61	'+'	Plus
Code			
Clear Tab Set	19		Clears or sets tabs
Hold			Capital Lock **
Mar Set	No action		
Mar Rel	26		Code Z
Code			
Insert	6		Code F
Prog	No action		
Move	9		Code I
Erase	8		Backspace
Tab	9		Code I
Lock			
Shift			
Backspace	8		Code H
Return	13		Code M
Space Bar	32	' '	Blank or Space

NOTE - The Hold key will make the letters 'a' through 'z' into capitals without making the upper row of the keyboard shift. This key is an ON/OFF action key which is defaulted to on.

Throughout the tables, some keys were described as a CODE ?, where the ? represents an alphabetic character. Most of these result in some action on the screen and are documented in the section that deals with the display system (page 10). Below is a translation of the remaining CODE keys.

CODE	ASCII DECIMAL VALUE	ACTION
C	3	Warm start
L	12	Form feed for printer
P	16	Activate/deactivates the printer
P'	16	Same action as for CODE P
1	93	Right Bracket
1'	91	Left Bracket
9'	123	Left Brace
0'	125	Right Brace
0a'	124	Vertical Bar
0b'	126	Tilde
Ma'	60	Less Than '<'
Mb'	62	Greater Than '>'
Pa	96	Accent
Pa'	95	Underscore
Mc'		Displays the Title Message

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The key to the right of the P key is called the Pa key. It has the characters '½','§','!','½' on its surface. The use of this key has presented some misunderstanding in the past because the characters that appear on the face of the key are not the characters that are communicated to CompuPak. In CompuPak this key represents the following ASCII characters:

Pa key	Backslash (ASCII dec. 92)
Shift Pa key	Up-side-down v (ASCII dec. 94)
Code Pa	Accent (ASCII dec. 96)
Code Shift Pa	Underline (ASCII dec. 95)

NOTE: When this key is used, the image that appears on the screen does not represent the correct ASCII character. This is a problem that is inherent with cursor addressing on the CPT 8000 screen.

The keys of the keyboard all repeat when held down. They repeat at a rate of 30 times each second.

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DISPLAY DRIVER

The display driver is the program which controls the way in which characters are displayed on the screen. The screen is 54 lines long and each line contains 80 characters. The top line is the status line and is used to indicate the message 'DATA PROCESSING' and to display error messages through a large window. The status line appears unavailable to the CP/M user, but may be accessed in programs that are written to run under CP/M.

In order to use the status line's large message window, the following sequence of characters must be sent to the screen: ESC (ASCII 27), 'E'(ASCII 69), '7'(ASCII 55), the message, '#'. Each message displayed features a number that is centered before the message itself appears. In order to initiate the centering, a 161.D (decimal value of the character in the character set) should follow that portion of the message that is to be centered in the window.

For example, if the string shown below were sent to the console device, using the constructs of the programming language being used, the window would appear and 8.53 would be centered. Then the message would scroll through the window and, at the completion of the scrolling, the window would be removed from the status line.

```
27,69,55,'8.53',161,'THE PRINTER NEEDS A NEW RIBBON.#'
```

The ASCII characters are supported in the following ways:

---- The printable characters with ASCII decimal values of 32 through 127 are supported as standard with these exceptions:

ASCII DECIMAL VALUE	KEY	DISPLAY
92	Pa	Inverted exclamation mark.
94	Pa'	Greek ae
95	Code Pa'	5's index mark
96	Code Pa	Daggar †
123	Code 9'	Down Arrow
124	Code 0a'	Paragraph
125	Code 0'	Up Arrow
126	Code 0b'	Displayed as '1/ '

NOTE: This is the character shown on the screen but is NOT the character being transmitted. Refer to the SPECIAL PROBLEMS section for a more detailed explanation.

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---- The following control codes are supported for the display system.

CODE	ASCII DECIMAL VALUE	ACTION
F	6	Return the cursor to the beginning of the current line.
G	7	Beep the buzzer.
H	8	Backspace the cursor one position.
I	9	Tab - Advance the cursor to the next position which is a multiple of eight.
J	10	Line Feed - Advance the cursor to the current column position of the next line.
K	11	Upspace - Move the cursor to the current column position of the previous line.
L	12	Forward Space - Advance the cursor to the next column position of the same line. Same result as the space bar.
M	13	Carriage Return - Advance the cursor to the beginning of the next line.
R	18	Retype - The current line is duplicated on the next line. The cursor does not advance.
S	19	Stop Output - Temporarily stops all processing. The next key stroke will activate processing.
T	20	RV - Reverse the video selection of the screen.
U	21	Clear to End of Line - Clears the remainder of the current line by inserting blank characters from the current column position to the the end of the 80-character current line, then advances the cursor to the first position of the next line.
X	24	Clear Line - Clears the current line and positions the cursor at the first position on the line.
Z	26	Form Feed - Clears the screen and homes the cursor to the first column of the first line. Also performs a form feed to the printer.
;	27	Escape - Used to activate various special sequences. See page 11 for a detailed description.
>	30	Home - Position the cursor to the beginning of the screen.

NOTE: Some of these control codes are CCP (Console Command Processor) implemented, while others are CPT implemented.

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Escape Sequences

ESC = The ASCII escape code followed by the character '=' represents absolute cursor addressing. The next two characters following the ESC = sequence represent the absolute cursor row and column respectively. These are often referred to as the X and Y values. The row and column may range from 1 to 80 and are indicated by using an ASCII character. The chart at the bottom of this page shows the correspondence.

ESC * Simulates the clear screen function. The cursor is returned to the home position.

ESC E A sequence that allows error messages to appear on the status line. This was described in detail earlier (page 9).

X or Y	ASCII CODE	X or Y	ASCII CODE	X or Y	ASCII CODE
1	Space	28	;	55	V
2	!	29	<	56	W
3	"	30	=	57	X
4	#	31	>	58	Y
5	$	32	?	59	Z
6	%	33	@	60	[
7	&	34	A	61	Pa key
8	'	35	B	62	]
9	(	36	C	63	Pa' key
10	)	37	D	64	
11	*	38	E	65	Code Pa
12	+	39	F	66	a
13	,	40	G	67	b
14	-	41	H	68	c
15	.	42	I	69	d
16	/	43	J	70	e
17	0	44	K	71	f
18	1	45	L	72	g
19	2	46	M	73	h
20	3	47	N	74	i
21	4	48	O	75	j
22	5	49	P	76	k
23	6	50	Q	77	l
24	7	51	R	78	m
25	8	52	S	79	n
26	9	53	T	80	o
27	:	54	U		

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PRINTER DRIVER

The printer driver is the program which controls the printer. Two different printers are available with CompuPak. The default printer is the Rotary V. However, the Rotary IV can be selected by running the CONFIG program (which is explained on page 16), or the STAT program.

One of the functions of the STAT command is to display or alter assignments to physical peripheral devices. The printer is called the list (LST) device in CP/M and LST=LPT means the LST device is currently assigned to a Rotary V. LST=UL1 means the LST device is currently assigned to a Rotary IV. The printer may be changed with the following commands:

```
STAT LST:=UL1:   (makes the printer a Rotary IV).
STAT LST:=LPT:   (makes the printer a Rotary V).
```

The printer accepts standard ASCII character codes. Control codes with ASCII values less than 32 are ignored except for the following:

CODE	ASCII DECIMAL VALUE	ACTION
H	8	Backspace - Backs the printer up one position.
J	10	Line Feed - Advance to the same position on the next line.
L	12	Form Feed - Advances the paper to the next page. A page is fixed at 66 lines.
M	13	Carriage Return - Return the cursor to the beginning of the line.
P	16	Activates/deactivates the printer.
Y	25	Turns the printer off line.
Z	26	End of File - Has the same effect as form feed, however, it also turns the printer off line.
;	27	Escape - Absolute cursor addressing. (See next page for a complete description)

The printer can be accessed while in CP/M Console Command Processor by pressing the PRINT (ASCII code 16) key. The printer will stay active until this key is pressed again.

The printer can use printwheels that feature 10, 12, or 15 characters per inch. The default pitch value is pica type (10 characters per inch). This value can be changed by running the CONFIG program.

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The position on the paper where the next character will be printed can be changed by invoking a curser addressing sequence. This sequence will advance the print positon to a new point that is relative to the previous position of the printer. An ESC (decimal 27) initiates the mode. The next character is interpreted to show the direction of the move.

The following table illustrates what these values are:

Character 1 (dec. 49) = move carriage to the right
Character 2 (dec. 50) = move carriage to the left
Character 3 (dec. 51) = move towards the top of the paper
Character 4 (dec. 52) = move towards the bottom of the paper

The next character is used to indicate the amount of the move. The ASCII characters from the blank (decimal 32) up to and including the lower case letter o (decimal 111) are interpreted as indicating a move of from one to eighty steps. Refer to the table given for absolute cursor addressing (page 11) for a complete breakdown. A step is defined to be 1/48 of an inch in the vertical direction, and 1/60 of an inch in the horizontal direction. Therefore, the number of steps per character is dependent on the printwheel being used. At 10 characters per inch, there are 6 steps per character. At 12 characters per inch, there are 5 steps per character, and at 15 characters per inch, there are 4 steps per character.

To illustrate this sequence, assume that the printer is to be moved from its current position to a point 1 1/2 inches below it. The character that will indicate a move down on the paper is the character 4. The amount of the move has to be calculated.

1 1/2 inches = 48 steps/inch * 1 1/2 = 72 steps = character g

The correct sequence in CBASIC is:

```
Print Chr$(27);"4g";
```

A maximum line length of 132 characters is allowed. If a line should be longer then this, or if a move command would attempt to move the printer beyond this length, all subsequent characters are printed on top of each other at the last position.

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COPY UTILITY

The copy utility is used to copy information back and forth between the Word Processing system and CompuPak's CP/M file system. The program can be entered by typing 'y' to the copy utility question that is presented to the user when the CompuPak interface disk is loaded. The program asks the user which direction to copy, and then asks for the CP/M file name and CPT Word Processing page labels.

When copying from Word Processing to CP/M, the first and last page labels need to be supplied. In the case where only one page is to be copied, the question that asks for the ending Word Processing page label should be answered with a blank carriage return. The program will try to copy all information contained on and between the first and last pages. When copying from CP/M to Word Processing, only the initial word processing page label is necessary. As pages become full a new page is created, using a label with its last character being a numeric character incremented by one from the previous page label.

In the case of copying from Word Processing pages to a CP/M file, the program asks the user for the first and last pages by label name. It will try to copy all pages between these two pages including the two pages. When a copy has been completed, the program asks the user if any more files are to be copied. When 'n' is returned the program exits and the CP/M operating system is invoked. For further information refer to the CompuPak CP/M Operations Manual (CPT Publication number 6621).

CP/M files created by the copy utility are terminated by the End-of-file character (ASCII decimal 26). Any CP/M file which is copied to the Word Processing filing system must be terminated by the End-of-file character or the copy will abort. There are character conversions made during the copy since different conventions are used for terminating lines in a CP/M file than in Word Processing filing system.

The following conversions (shown using ASCII decimal values) take place. The arrows show the direction of the copy, where the head of the arrow points to the destination.

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Word Processing		CP/M	
degree	96 <---------->	94	inverted v
1/4	92 <---------->	95	underscore
section sym.	157 <---------->	92	backslash
1/2	124 <---------->	96	accent
Carriage Return	<---------->	CR character, Line feed char.	

Coded characters ----------> Blanks (one-way conversion)
Blank <---------- Tab (one-way conversion)

All characters with an ASCII decimal value of less then 31, except for the TAB, End of File, and CR, are ignored when converting from CP/M to Word Processing files.

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Konto-Nr. 65 159
Dresdner Bank
Konto-Nr. 9 009 863

AG Köln: HRB 6044
GfG: W. B. MELZER
Tel.: (0 22 03) 5 30 94
Telex: 08-874 553

CPT
TEXT-COMPUTER

TEXT-COMPUTER
VERTRIEBS GMBH
KÖLNER STR. 35
5000 KÖLN 90

CONFIG UTILITY

The CONFIG utility is used to change certain features of the system from their default condition. This utility resides as a COM file on the Compupak CP/M disk and may be invoked by typing CONFIG after the A> symbol.

A series of questions are asked that allow the user to choose the type of printer that is attached to the system (Rotary IV or V), the size of the printwheel (10 pitch, 12 pitch, or 15 pitch), and the screen format (black characters on a white screen or white characters on black).

An initial command line to CP/M may also be specified. This command must be in the proper format for it to be executed by CP/M. This command will be executed at each cold start until such time that the CONFIG program is invoked and a new or no command is specified.

The information supplied by the user of the CONFIG utility will be used to reconfigure the system, and will remain in effect until such time that the CONFIG utility is called to make a change.

When the disk copy utility is used to duplicate a disk, or when SYSMOV is used to copy the operating system, the configuration information is also carried over to the destination disk.

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DISK COPY UTILITY

Application programs available under CP/M use data disks that must be duplicated at certain intervals to guard against accidental destruction of valuable data. To copy all data from one disk to another disk, the DSCOPY utility is available. The user invokes this program by typing DSCOPY after the A> symbol.

The user need only follow the instructions as they appear on the screen in order to correctly perform a disk copy. An exit is provided at the start of this utility for a user who may enter this program accidentally.

The disk to be copied is placed in drive A, as specified in the instructions that appear on the screen, and the disk that is to contain an exact copy is placed in drive B. This program does not check to see that the disk is blank. Therefore the user must guard against inserting a disk in drive B that contains information which should not be destroyed.

A final question is asked of the user to insure that the proper disks are in the correct drives, and then the copy procedure begins. If the user has more disks which need to be duplicated, this procedure may be repeated by answering 'Y' to the next question that appears on the screen.

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The CompuPak CP/M operating system is contained on the CompuPak CP/M disk along with special programs such as DSCOPY and CONFIG. Additional application programs may be purchased from software centers throughout the United States and placed on this disk. In addition, there are programs which provide information about the system, and are termed the library commands of CP/M. These programs are documented by Digital Research in the documents, "An Introduction to CP/M Features and Facilities", 1978, and "CP/M 2.0 User's Guide for CP/M 1.4 Owners", 1979. The built-in commands are described briefly as follows:

DIR -lists file names in the current directory.

ERA -allows specified files to be erased.

REN -allows for the renaming of a file.

SAVE -allows for the saving of the contents of memory in a file.

TYPE -displays the contents of a file on the screen

STAT -provides statistics concerning the characteristics of the files and the status of the operating system.

PIP -(Peripherial Interchange Program) used to copy files from a disk to other disks or devices such as a printer.

SUBMIT-allows several programs to be submitted for execution at the same time. These programs are then queued up for execution.

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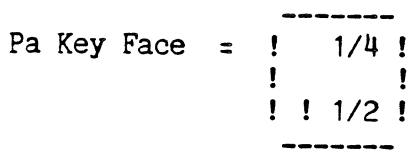
Individuals that have been using CompuPak to execute their own programs have encountered some problems that are unique to the CPT 8000 while it is being used for data processing. This section is devoted to a more detailed explanation of some of these problems and also supplies information on other features that the programmer may wish to use.

1. The Pa key (key to the right of the P key) has been the source of many problems. (Please refer to the illustration shown below). The characters that appear on the face of this key are not the characters that are being communicated while using the data processing system. This is complicated even further by the fact that the characters that appear on the screen are yet a third set of characters. Most of the characters that are actually being transmitted when using the Pa key, are characters that the screen does not have the ability to reproduce. The table given below shows the Pa key state, the action that occurs on the screen and the character actually transmitted while in Data Processing mode.



KEY STATE	DATA PROCESSING	
	Screen	Transmitted
Regular	Inverted exclamation	Backslash
Shifted	Greek ae	Inverted v
Code	Daggar	Accent
Shift Code	5's index mark	Underscore

WARNING:
When converting a file from word processing to data processing, the characters 1/2, 1/4, and the degree symbol are converted to the accent, underscore, and inverted v respectively. The exclamation mark is unchanged.

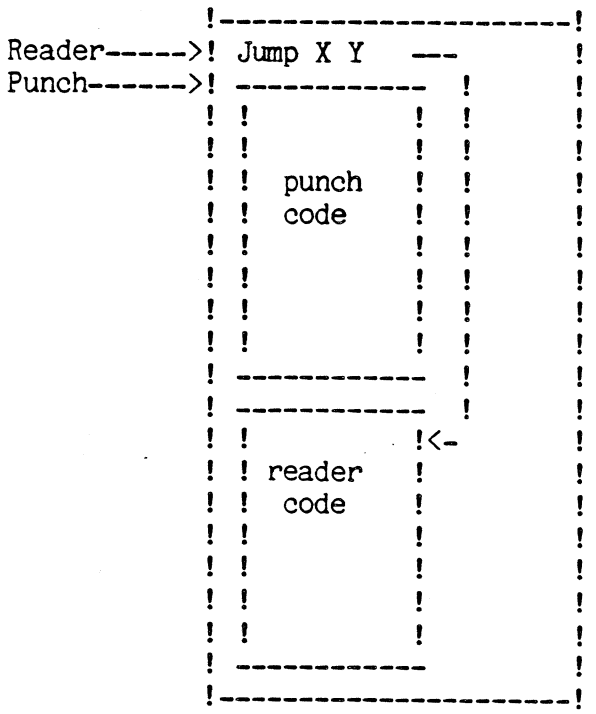
2. The backslash character, which is used extensively in CBASIC programs, does not exist on the CPT 8000. In order to make this character available, the section symbol of word processing (CODE SHIFT 6) is converted to the backslash charracter during the execution of the copy utility. Therefore, if a file is being created under word processing, and the file will be converted

to a data processing file by using the copy utility, a backslash character will be produced wherever a CODE SHIFT 6 is inserted in the word processing text. Be aware that if the data processing file is then displayed on the screen, an inverted exclamation mark will appear wherever the backslash should appear.

3. There are four other characters whose image on the screen is not the same as the character that is transmitted. The table below contains the information concerning these characters.

KEY	ASCII DECIMAL VALUE	SCREEN	TRANSMITTED
Code 9'	123	down arrow	left brace
Code 0'	125	up arrow	right brace
Code 0a'	124	paragraph	vertical bar
Code 0b'	126	1/	tilde (squiggle)

4. Some users of CompuPak may wish to use a different driver, printer, or a communications device. A window exists that will allow up to a 512-byte section of code to be inserted for this purpose. This window exists on track one, sectors 22-25. The first byte is the designated entry point for a reader device, and the fourth byte is the entrance point for a punch device. If the reader entrance is to be used, the code at the beginning of the work area should be a jump to some area further into the work area. The illustration shown below represents the 512 bytes of work area. Notice the location of the two entrance points.



8000 CODE SET

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	NON-ESC F
0	0	16	32 SPACE	48 0	64 @	80 P	96 o	112 p	128 .	144 •	160	176	192 REV VIDEO	208	224 PKSP	240 BLANK
1	1	17	33 !	49 1	65 A	81 Q	97 a	113 q	129 ı	145 ±	161	177	193 HORZ SCROLL	209	225	241 0
2	2	18	34 "	50 2	66 B	82 R	98 b	114 r	130 ł	146 Ç	162	178	194 JMP 1	210	226	242 ••
3	3	19	35 #	51 3	67 C	83 S	99 c	115 s	131 ■	147 ç	163	179	195 JMP 2	211	227	243 /
4	4	20	36 $	52 4	68 D	84 T	100 d	116 †	132 Ł	148 Ø	164	180	196 U.L. CHAR	212	228	244 \
5	5	21	37 %	53 5	69 E	85 U	101 e	117 u	133 ł	149 ø	165	181	197 U.L. WORD	213	229	245 ^
6	6	22	38 &	54 6	70 F	86 V	102 f	118 v	134 ‼	150 Æ	166	182	198 U.L. LINE	214	230	246 v
7	7	23	39 '	55 7	71 G	87 W	103 g	119 w	135 ^	151 œ	167	183	199 END U.L.	215	231	247 ~
8	8	24	40 (	56 8	72 H	88 X	104 h	120 x	136 o	152 ß	168	184	200	216	232	248
9	9	25	41)	57 9	73 I	89 Y	105 i	121 y	137 ▶	153 ¥	169	185	201	217	233	249
A	10	26	42 *	58 :	74 J	90 Z	106 l	122 z	138 TM	154 f	170	186	202	218	234	250
B	11	27	43 +	59 ;	75 K	91 [	107 k	123 ↓	139 ®	155 £	171	187	203	219	235	251 —
C	12	28	44 ,	60 <	76 L	92 1/4	108 l	124 1/2	140 ©	156 ¶	172	188	204	220	236	252 =
D	13 CR	29	45 —	61 =	77 M	93]	109 m	125 ↑	141 ◀	157 §	173	189	205	221	237	253 • (KEEP)
E	14	30	46 •	62 >	78 N	94 3/4	110 n	126 /	142 °	158 ¡	174	190	206	222	238	254 (PRINT)
F	15	31	47 /	63 ?	79 O	95 ¢	111 o	127 d'	143 |	159 ¿	175	191	207	223	239	255 DEL

		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	APPRO
		TOLERANCES	ENGINE

8000 Character	Code Octal	Decimal	Hex
Space	040	32	20
!	041	33	21
"	042	34	22
#	043	35	23
$	044	36	24
%	045	37	25
&	046	38	26
'	047	39	27
(	050	40	28
)	051	41	29
*	052	42	2A
+	053	43	2B
,	054	44	2C
-	055	45	2D
.	056	46	2E
/	057	47	2F
0	060	48	30
1	061	49	31
2	062	50	32
3	063	51	33
4	064	52	34
5	065	53	35
6	066	54	36
7	067	55	37
8	070	56	38
9	071	57	39
:	072	58	3A
:	073	59	3B
<	074	60	3C
=	075	61	3D
>	076	62	3E
?	077	63	3F

8000 Character	Code Octal	Decimal	Hex
@	100	64	40
A	101	65	41
B	102	66	42
C	103	67	43
D	104	68	44
E	105	69	45
F	106	70	46
G	107	71	47
H	110	72	48
I	111	73	49
J	112	74	4A
K	113	75	4B
L	114	76	4C
M	115	77	4D
N	116	78	4E
O	117	79	4F
P	120	80	50
Q	121	81	51
R	122	82	52
S	123	83	53
T	124	84	54
U	125	85	55
V	126	86	56
W	127	87	57
X	130	88	58
Y	131	89	59
Z	132	90	5A
[	133	91	5B
1/4	134	92	5C
]	135	93	5D
1/4	136	94	5E
¢	137	95	5F

8000 Character	Code Octal	Decimal	Hex
°	140	96	60
a	141	97	61
b	142	98	62
c	143	99	63
d	144	100	64
e	145	101	65
f	146	102	66
g	147	103	67
h	150	104	68
i	151	105	69
j	152	106	6A
k	153	107	6B
l	154	108	6C
m	155	109	6D
n	156	110	6E
o	157	111	6F
p	160	112	70
q	161	113	71
r	162	114	72
s	163	115	73
t	164	116	74
u	165	117	75
v	166	118	76
w	167	119	77
x	170	120	78
y	171	121	79
z	172	122	7A
reserved	173	123	7B
1/2	174	124	7C
reserved	175	125	7D
reserved	176	126	7E
reserved	177	127	7F

ASCII Control	ASCII Function	8000 Character	Code Octal	Decimal	Hex
CTL @	NUL	(Code =) @	000	0	00
CTL A	SOH	(Code =) A	001	1	01
CTL B	STX	(Code =) B	002	2	02
CTL C	ETX	(Code =) C	003	3	03
CTL D	EOT	(Code =) D	004	4	04
CTL E	ENQ	(Code =) E	005	5	05
CTL F	ACK	(Code =) F	006	6	06
CTL G	BEL	(Code =) G	007	7	07
CTL H	BS	Backspace	010	8	08
CTL I	HT	Tab	011	9	09
CTL J	LF	(Code =) J	012	10	0A
CTL K	VT	(Code =) K	013	11	0B
CTL L	FF	(Code =) L	014	12	0C
CTL M	CR	Return	015	13	0D
CTL N	SO	(Code =) N	016	14	0E
CTL O	SI	(Code =) O	017	15	0F
CTL P	DLE	(Code =) P	020	16	10
CTL Q	DC1	(Code =) Q	021	17	11
CTL R	DC2	(Code =) R	022	18	12
CTL S	DC3	(Code =) S	023	19	13
CTL T	DC4	(Code =) T	024	20	14
CTL U	NAK	(Code =) U	025	21	15
CTL V	SYN	(Code =) V	026	22	16
CTL W	ETB	(Code =) W	027	23	17
CTL X	CAN	Erase	030	24	18
CTL Y	EM	(Code =) Y	031	25	19
CTL Z	SUB	(Code =) Z	032	26	1A
CTL [	ESC	(Code =) [	033	27	1B
CTL \	FS	(Code =) <	034	28	1C
CTL]	GS	(Code =)]	035	29	1D
CTL ^	RS	(Code =) >	036	30	1E
CTL _	US	(Code =) ?	037	31	1F

8000 Character	ASCII Equivalent	Code Octal	Decimal	Hex
Line return (Backspace to the left margin)	ESC/BS	033/010	27/8	1B/08
Coded Tab	ESC/HT	033/011	27/9	1B/09
Coded CR	ESC/CR	033/015	27/13	1B/0D
Coded Space	ESC/Grave (')	033/140	27/96	1B/60
Coded hyphen	ESC/Greater-than symbol (>)	033/076	27/62	1B/3E
Underscore	ESC/Shift D	033/104	27/68	1B/44
Vertical Bar	ESC/Underscore(ASCII)	033/137	27/95	1B/5F

Non-spacing characters:

Control Bar	ESC/ 1/2	033/174	27/124	1B/7C
Hat Code	ESC/Tilde (~)	033/176	27/126	1B/7E
	DEL	177	127	7F

Some codes may not be present in current software.

Preliminary Specification - subject to change.