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CP/M*

Versions 1.4 & 2.X

**Programmer's
Reference
Guide**

REVISED EDITION BY SOL LIBES,
Editor of *Microsystems*

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BUILT-IN COMMANDS

```

DIR                                     {current drive
DIR d:                                {designated drive
DIR filename.typ                      Search for named file, current drive
DIR *.typ                            Display all files of named type, curr drv
DIR filename.*                       Display all types of designated filename
DIR x????.*                          Display all filenames 5 characters
                                      long and start with letter x

TYPE filename.typ                    {current drive
TYPE d:filename.type                 {designated drive

ERA filename.typ                     {named file, current drive
ERA *.*                             {all files, curr drv, V2.x curr user
ERA *.typ                           Erase {all files {designated {type
ERA d:filename.typ                  {named file}          {drive
ERA filename.*                      {all types of named file, curr drv

REN nuname.typ=olname.typ } RENAME file {current drive
REN d:nuname.typ=olname.typ}          {designated drive

SAVE n filename.typ                 {current drive
SAVE n d:filename.typ              {designated drive
                                   n pages (page=256 bytes) start @ 100H

d:                                  Switch to designated disk drive
                                   A-D V1.4; A-P V2.x

USER n                             Change user area (Version 2.x)

```

ED COMMANDS

nA	Append n lines to buffer (n=0 -use half of buffer)
B	{beginning}
-B	Move pointer to {end} of file
nC	{forward n characters}
nD	Delete n characters forward
E	End edit, close file, return to CP/M
nFs	Find n-th occurrence of string 's'
H	end edit, move pointer to beginning of file
I	Insert text at pointer until ^Z typed
Is	Insert string at pointer
nK	Kill n lines starting at pointer
nL	move pointer n lines
nMx	execute command string 'x' n times
nNs	global F-command- until end of file
O	abort ED, start over with original file
nP	list next n pages of 23 lines (n=0 -current page)
Q	Quit without changing input file
Rfn	Read fn.LIB into buffer at current pointer
nSx^Zy	Substitute string 'y' for next n forward occurrences of string 'x'
nT	Type n lines
U	change lower case to upper case (next entry)
V	enable internal line number generation
nW	Write n lines to output file (start at beginning of buffer)
nX	Write next n lines to file 'X\$\$\$\$\$\$\$.LIB'
nZ	Pause n/2 seconds (2MHz)
n	{n lines}
<CR>	Move {forward {1 line}} and type one line
-	{backward}
n:x	move to n line number and perform 'x' command
:mx	perform command 'x' from current line to line m
n::mx	move to n line number and perform command 'x' through line number m

note: "-" valid on all positioning and display commands
for backward movement (e.g. -nC)

PIP COMMANDS

PIP	Initiate Peripheral Interchange Program
*d:=s:filename.typ	Copy named file from source drv
d:nuname.=s:olname.typ	Copy&change filename to destinat drv
PIP d:=s:filename.typ	Initiate PIP and copy named file
PIP d:=s:*. *	from source drv {all files
PIP d:=s:filename.*	to {all named files
PIP d:=s:*.typ	destination drv {all files named typ
PIP LST:=filename.typ	{list device
PIP PUN:=filename.typ	send named file to {punch device
PIP CON:=filename.typ	{console device
PIP filename.typ=RDR:	Copy data from reader device to named file (current drive)
*nuname.typ=aname.typ,bname.type,cnametyp	{ASCII } copy&con-
*d:nuname.type=s:aname.typ,s:bname.typ	{ } concatenate
*nuname.typ=aname.typ[X],bname.typ[X]	{non-ASCII} files
PIP LST:=aname.typ,bname.typ	send files in sequence
PIP LST:=s:name.typ,s:name.typ	to list device

PIP PARAMETERS

[B] - read data block until ^S character
 [Dn] - delete characters past column n
 [E] - echo all copy operations to console
 [F] - remove form feeds
 [Gn] - get file from n user area - V2.x
 [H] - check for proper hex format
 [I] - same as H plus ignores ":00"
 [L] - change all upper case characters to lower case
 [N] - add line numbers with leading zeros suppressed
 [N2] - same as N plus leading zeros & tab
 [O] - object file transfer; ignores end-of-file
 [P] - {insert form feed every {60} lines
 [Pn] - {n}
 [Qstring^Z] - Quit copying after {string is found
 [Sstring^Z] - Start copying when {string is found
 [R] - read SYS file (V2.x)
 [Tn] - expand tab space to every n columns
 [U] - change all lower case characters to upper case
 [V] - verify copied data
 [W] - delete R/O files at destination (V2.x)
 [X] - copy non-ASCII files
 [Z] - zero parity bit on all characters in file

PIP KEYWORDS

CON: CONsole device (defined in BIOS)
 EOF: send End-of-File (ASCII-^Z) to device
 INP: INPut source (patched in PIP)
 LST: LiST device (defined in BIOS)
 NUL: send 40 NULLs to device
 OUT: OUTput destination (patched in PIP)
 PRN: same as LST;; tabs every 8th character, numbers
 lines & page ejects every 60 lines with
 initial eject
 PUN: PUNch device } defined in BIOS
 RDR: ReaDeR device }

refer to IOBYTE section for additional physical devices

ASM CONVENTIONS

labels followed by colon 1- 6 alphanumeric characters
symbol (eg. EQU) no colon first must be alpha, ? or .

Assembly Program Format (space separates fields)
label: opcode operand(s) ;comment

Operators (unsigned)

a+b a added to b
a-b difference between a and b
+b 0+b (unary addition)
-b 0-b (unary subtraction)
a*b a multiplied by b
a/b a divided by b (integer)
a MOD b remainder after a/b
NOT b complement all b-bits
a AND b bit-by-bit {AND} of a and b
a OR b {OR}
a XOR b {XOR}
a SHL b shift a {left} b bits, end off, zero fill
a SHR b {right}

Hierarchy Of Operations

highest: * / MOD SHL SHR
- +
NOT
AND
lowest: OR XOR

Constants

Numeric (post radix)
B=binary
0,Q=octal
D=decimal(default)
H=Hexidecimal
ASCII - in quotes (e.g. 'A')

Pseudo-ops

ORG const Set program or data origin (default=0)
END start End program. Optional address where execution begins
EQU const Define symbol value(may not be changed)
SET const Define symbol value(may be changed later)
IF const Assemble block conditionally until ENDIF
ENDIF Terminate conditional assembly block
DS const Define storage space for later use
DB byte[,byte...,byte] Define bytes as numeric or ASCII constants
DW word[,word...,word] Define word(s) (two bytes)

const=constant (true if bit-0=1 otherwise false)

ASM ERROR CODES

D Data error (element cannot be placed in data area)
E Expression error (ill-formed expression)
L Label error
N Not implemented
O Overflow (expression too complicated to compute)
P Phase error (label has different values on each pass)
R Register error (specified value not compatible with op code)
U Undefined label (label does not exist)
V Value error (operand improper)

TRANSIENT COMMANDS

DDT	Initiate Dynamic Debugger Tool program
DDT filename.typ	Initiate DDT and load named file
ASM filename	Assemble named ASM {current drive
ASM d:filename	file on: {designated drive
ASM filename.abc	a=source file drv; b=HEX file destination drv (Z=skip); c=PRN file destination drv (X=console, Z=skip)
LOAD filename	Make .COM file from {current drive
LOAD D:filename	named HEX file on: {designated drive
DUMP filename.typ	Display file in hex {current drive
DUMP d:filename.typ	{designated drive
MOVCPM n	Create {and execute nKbyte CP/M system image of nKbyte CP/M system image of maxKbyte CP/M for SYSGEN or SAVE
MOVCPM n *	
MOVCPM * *	
SYSGEN	Initiate SYStem GENerate program
SUBMIT filename parameters	Execute SUB file using optional parameter(s)
XSUB	Execute eXtended SUBmit program (V2.x)
ED filename.typ	Execute EDitor program to create or edit named file
ED d:filename.typ	
STAT	Display STATus-R/W or R/O {current drv
STAT d:	and available disk space {named drive
STAT DEV:	Display {DEVICE assignments VALID device assignments DiSK characteristics current USer areas size of file file characteristics {curr drv named drv
STAT VAL:	
STAT DSK:	
STAT USR:	
STAT filename.typ \$S	
STAT filename.typ	Change {designated drive to Read-only named file to {Read-only Read-Write System file Drctry file
STAT d:filename.typ	
STAT d:=R/O	
STAT filename.typ \$R/O	
STAT filename.typ \$R/W	Change {named file to {Read-only Read-Write System file Drctry file
STAT filename.COM \$SYS	
STAT filename.COM \$DIR	Change general device (CON:,LST:,PUN: and/or RDR:) assignment of physical device (see IOBYTE)
STAT gd:=pd:	

CP/M DISK FORMAT

Media: 8" soft-sectored floppy-disk single density
(IBM 3740 standard)

Tracks: 77 (numbered 0 thru 76)

Sectors/Track: 26 (numbered 1 thru 26)

Bytes/Sector: 128 data bytes (one logical record)

Storage/Disk: 256,256 bytes (77*26*128)

File Size: any number of sectors from zero to
capacity of disk.

Extent: 1Kbytes-8 sectors (smallest file space allocated)

Skew: 6 sectors standard (space between consecutive
physical sectors on track): 1-7-13-19-25-5-11-
17-23-3-9-15-21-2-8-14-20-26-6-12-18-24-4-10-16-22

System: Track 0 & 1 (optional)
Track-0, sector 1: boot loader
Track-0, sectors 2-26: } CCP & BDOS
Track-1, sectors 1-17: }
Track-1, sectors 18-26: CBIOS

Directory: Track 2: 16 sectors typ. 32-bytes/entry
(64 entries typ.) - extents-0 and 1

User File Area: Remaining sectors on Track-2 and -3 to 76
Extents 2 and above

COMMAND CONTROL CHARACTERS

charac	function	ASCII code
C	Reboot CP/M (warm boot)	03H
E	Start new line	05H
H	Backspace and delete (V2.x)	08H
I	Tab 8 columns	09H
J	Line feed	0AH
M	Carriage return	0DH
P	Printer on/printer off	10H
R	Retype current line	12H
S	Stop display output - any character except ^c restarts output	13H
U	Delete line	15H
X	same as ^U (V1.4)	18H
	backspace to start of line (V2.x)	
Z	End of console input (ED & PIP)	1AH
delete	Delete and display	7FH
rubout	last character (tape only)	7FH

IOBYTE (0003H)

Device		LST:	PUN:	RDR:	CON:
Bit Position		7 6	5 4	3 2	2 1
Dec	Binary				
0	00	TTY:	TTY:	TTY:	TTY:
1	01	CRT:	PTP:	PTR:	CRT:
2	10	LPT:	UP1:	UR1:	BAT:
3	11	UL1:	UP2:	UR2:	UC1:

TTY: TeleType
 CRT: Cathode Ray Tube type terminal
 BAT: BATch process(RDR=input,LST=output)
 UC1: User defined Console
 LPT: Line Printer
 UL1: User defined List device
 PTR: Paper Tape Reader
 UR1: } User defined
 UR2: } Reader devices
 PTP: Paper Tape Punch
 UP1: } User defined Punch
 UP2: } devices

FILE TYPES

ASC ASCII text file, usually Basic source
 ASM ASseMblY language file (source for ASM program)
 BAK BACkUp copy file (created by editor)
 BAS BASic source program file, usually tokenized
 COM COMmAnd file (transient executable program)
 DAT DATa file
 DOC DOCument file
 FOR FORtran source program file
 INT INTermediate Basic program file (executable)
 HEX HEXadecimal format file (for LOAD program)
 LIB Library file used by macro assembler
 PLI PL/I source file
 PRN PRInT file (source and object produced by ASM)
 REL RELocatable module
 SAV System file (V2.x)
 SUB SUBmit text file executed by SUBMIT program
 SYM SID symbol file
 TEX TEXt formatter source file
 XRF Cross reference file
 \$\$\$ Temporary file

Filename - 8 characters maximum
 Filetype - 3 characters maximum

Invalid filename and filetype characters:
 < > . , ; : = ? []

DDT COMMANDS

A sad	Assemble symbolic code ; start at sad
D	Dump RAM
D sad	to console
D sad,ead	from:
	<div> <div></div> <div>cad; 16 lines</div> <div>sad; 16 lines</div> <div>sad thru ead</div> </div>
F sad,ead,const	Fill RAM from sad thru ead with constant
G	Start
G sad	program
G sad,bpl	execution
G sad,bpl,bp2	at:
G,bpl,bp2	<div> <div></div> <div>saved PC</div> <div>sad</div> <div>sad and stop at bpl</div> <div>sad and stop at bpl or bp2</div> <div>cad and stop at bpl or bp2</div> </div>
H a,b	Display hex a+b and a-b
I filename	Set up FCB
I filename.typ	(5CH) for:
	<div> <div>user code</div> <div>R-command (HEX or COM file)</div> </div>
L	Dissassemble
L sad	RAM
L sad,ead	from:
	<div> <div></div> <div>cad; 12 lines</div> <div>sad; 12 lines</div> <div>sad thru ead</div> </div>
M sad,ead,nad	Move RAM block from sad thru ead to nad
R	Read file specified by I command to RAM at
R offset	normal address + optional offset
S sad	Substitute into RAM starting at sad
T n	Execute n instructions (default=1) with register dump (trace)
U n	Execute n instructions (default=1) with register dump after last instruction
Xr	Examine/change registers or flags
X	Examine registers (flag reg:C=carry, Z=zero, M=sign, E=parity, I=aux carry)

cad=current address sad=start address
nad=new address ead=end address
?=error, can mean: file cannot be opened,checksum error
in HEX file or Assembler/Dissassembler overlayed.

LOGIN BYTE (0004H)

low nibble = current drive (0=A,1=B,etc.)
high nibble = current user (V2.x only)

FILE CONTROL BLOCK

Byte(s)	function
0	dr Drive code (0=current, 1=A, 2=B, etc)
1-8	f1-f8 File Name
9-11	t1-3 File Type t1=1-R/O; t2=1-SYS
12	ex current EXTent number
13	s1 reserved
14	s2 =0 on BDOS call to
	Open,Make,search
15	rc extent Record Count
16-31	d0-dn Disk map
32	cr current record for r/w
33-35	rn random record number

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
dr|f1|f2|f3|f4|f5|f6|f7|f8|t1|t2|t3|ex|s1|s2|rc

16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35
d0|d1|d2|d3|d4|d5|d6|d7|d8|d9|d10|d11|d12|d13|d14|d15|cr|r0|r1|r2

MEMORY ALLOCATIONS

(b=memsize-20K V2.x; memsize-16K V1.4)

	Hex Memory Locations	Contents
System Scratch Area (0-FFH)	0-2	jump to BIOS warm start entry point
	3	IOBYTE
	4	login drive number and current user
	5-7	jump to BDOS
	8-37	reserved: interrupt vectors & future use
	38-3A	RST7-used by DDT or SID programs
	3B-3F	reserved for interrupt vector
	40-4F	scratch area used by CBIOS
	50-5B	not used
	5C-7C	File Control Block (FCB) area (default)
Transient Program Area	7D-7F	Random record position-V2.x (default)
	80-FF	DMA buffer area (128 bytes) for input and output (default)
	{100...33FF+b}	COM file area {V2.x
	{100...28FF+b}	{V1.4
	CCP area {3400+b-3BFF+b}	Console Command {V2.x
	{2900+b-30FF+b}	Processor {V1.4
	BDOS area {3C00+b-49FF+b}	Disk Operating {V2.x
	{3100+b-3DFF+b}	System {V1.4
	BIOS area {4A00+b-4FFF+b}	I/O system {V2.x
	{3E00+b-3FFF+b}	{V1.4

BIOS ENTRY POINTS

Hex addr	Vector Name	Function	Value Passed	Value Returned
**00	BOOT	cold		C=0
**03	WBOOT	warm		C=drv no
**06	CONST	check for console ready		A=const
**09	CONIN	read from console		A=chara
**0C	CONOUT	write to {console		
**0F	LIST	{list device}	C=chara	
**12	PUNCH	{punch device}		
**15	READER	read from reader device		A=chara
**18	HOME	move head to track-0		
**1B	SELDISK	select drive	C=drv no	HL=dph*
**1E	SETTRK	{track number	C=trk no	
**21	SETSEC	set {sector number	C=sec no	
**24	SETDMA	{DMA address	BC=DMA	A=dskst
**27	READ	read {selected sector		
**2A	WRITE	write}		
**2D*	LISTST	get list status		A=lstst
**30*	SECTTRAN	sector translate	BC=1secno	HL=pysec
		subroutine	DE=smap	

const=console status
 00=idle
 FF=data avail
 dph=disk parameter/
 header address
 dskst=disk status
 00=OK
 01=error
 lstst=list status
 00=busy
 FF=ready

1secno=logical sector number
 pysec=physical sector number
 smap=sector interlace map
 address
 chara=character
 drv no=drive number
 trk no=track number
 sec no=sector number
 DMA=DMA address
 * not used in V1.4
 **= contents of location 0002H

BDOS FUNCTION CALLS

(request to BDOS to perform specified functions)

	Function Number in C reg		Function	Value Passed to BDOS in DE(or E)regs	Value Returned in A (or HL) regs
	Dec	Hex			
Peripheral I/O	0	00	system reset	--	--
	1	01	console read	--	char
	2	02	console write	E=char	--
	3	03	reader read	--	char
	4	04	punch write	{E=char	--
	5	05	list write		--
	6	06	direct con IO (V2.x)	E= {FFH(input) char(output)	0=not ready char
	7	07	get IOBYTE	--	IOBYTE
	8	08	set IOBYTE	E=IOBYTE	--
	9	09	print string	string addr	--
	10	0A	read console buffer	addr of data buffer	chars in buffer
	11	0B	get console status	--	00(not ready) FF(ready)
	12	0C	lift head(V1.x) get vers (V2.x)	-- --	-- HL=version no.
	13	0D	reset disk **		--
Disk I/O	14	0E	select disk	{E=drive no	--
	15	0F	open file		
	16	10	close file	{FCB addr	{dir FF(not found)
	17	11	search for file		
	18	12	search for next	--	*
	19	13	delete file		00(valid)
	20	14	read next recrd	{FCB addr	{dir FF(disk full)
	21	15	write next recd		{directory code FF(not found)
	22	16	create file		HL=drive code A=cdn
	23	17	rename file	old file FCB addr	--
V2.x only	24	18	get login vectr	-- (V1.4)	HL=ava
	25	19	get disk no.	--	--
	26	1A	set DMA addr.	DMA addr	HL=R/O vector
	27	1B	get alloc vectr	--	dir
	28	1C	write protect	--	HL=dpba
	29	1D	get R/O vector	--	
	30	1E	set file attrib	FCB addr	
	31	1F	get addr (disk parameters)	--	
	32	20	set/get user code	E= FFH(get) user code(set)	current code --
	33	21	read random		{error code***
V2.2 & later	34	22	write random	{FCB addr	
	35	23	compute file size	{(r0,r1,r2 format)	{random record field set
	36	24	set random rec		
	37	25	reset drive	drive vector	0
	40	28	write random with zero fill	FCB addr	return code
not used	38	26			
	39	27			

* V1.4 none

** V1.4 initializes system and selects A drive

*** error codes: 01-reading unwritten data
03-cannot close current extent
04-seek to unwritten extent
05-directory overflow (write only)
06-seek past physical end of disk

char=character (ASCII)

addr=address

dir =directory code

cdn =current drive number (A=0,B=1,etc)

dpba=disk parameter block address

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