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Issue 1

UNIX™ System V
DOCUMENTER'S WORKBENCH™
Software Release 2.0

Handbook

NOTICE

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Introduction

This handbook, a memory jogger for accomplished users, reviews the commands and features of the DOCUMENTER'S WORKBENCH Software. If you need more information, refer to the *User's Guide* (310-004) or to the *Technical Discussion and Reference Manual* (310-005). If you are a beginner with the DOCUMENTER'S WORKBENCH Software, you might want to refer to the *Handbook for New Users* (310-009).

This handbook is organized as follows:

- The "Alphabetical List of Commands" section briefly describes the purpose of each formatting command, presents its command line syntax and describes what its options do.
- The "**mm** Macros" section summarizes the macros for preparing and formatting documents using the **mm** macro package.
- The "**mv** Macros" section summarizes the macros for preparing and formatting view graphs and slides using the **mv** macro package.
- The "**man** Macros" section summarizes the macros for preparing and formatting descriptions of commands in the style of UNIX manual pages using the **man** macro package.
- The "**nroff/troff** Requests" section lists requests recognized by the **nroff/troff** formatter.
- The "Preprocessor Commands and Macros" section lists commands and macros you use with the **tbl**, **eqn**, **neqn**, and **pic** preprocessors.
- The "**troff** Characters" section presents the special characters available with **troff**.

This handbook observes the following conventions when discussing command syntax:

[]	encloses an optional argument
()	encloses the default value for a register or string
{}	encloses a list of arguments from which one should be selected

italic text shows where you may substitute appropriate values

bold text shows where you must type exactly what is specified

Some sections of this handbook use additional conventions. These will be explained where they are used. You will have to check with your system administrator to determine which of the output devices listed in the command descriptions is locally available.

Alphabetical List of Commands

checkmm checks how you use Memorandum Macros (**mm**) and **tbl** and **eqn** delimiters

checkmm [*files*] [−]

(Also, see the "**mm** Macros" section.)

---

daps interprets files created by **troff** for the Autologic APS-5 phototypesetter

daps [−**b**] [−**r**] [−**t**] [−**w**] [−**h** *string*] [−**o** *list*] [−**s** *n*] [−−] [*files*] [−]

−**b** reports whether typesetter is busy; does not print output

−**r** reports the number of 8.5x11 inch pages generated by the current job

−**t** directs output to the standard output instead of the typesetter

−**w** waits for typesetter to become free, then prints output

−**h** *string* prints *string* in the current job's header

−**o** *list* prints pages whose numbers you give in the *list*; separate page numbers or page ranges in the *list* with commas (e.g., **3,7-10**)

−**s** *n* stops after every *n* pages of output

−− delimits the end of options

− reverts to the standard input

---

diffmk marks differences between two versions of a file

diffmk *oldfile newfile diff_file*

diffmk compares *oldfile* and *newfile* and generates *diff_file*, which when formatted, highlights the differences

between the old and new files. *oldfile* or *newfile* may be standard input.

---

di10 interprets files created by **troff** for the Imagen Imprint-10 laser printer

di10 [**−o** *list*] [**−t**] [**−−**] [*files*] [**−**]

−o *list*	prints pages whose numbers you give in the *list;* separate page numbers or page ranges in the *list* with commas (e.g., **3,7-10**)
−t	directs output to the standard output instead of the typesetter
−−	delimits the end of options
−	reverts to the standard input

---

eqn translates **eqn** control lines into code that **troff** can use to typeset mathematical symbols

[**−d** *xy*] [**−p** *n*] [**−s** *n*] [**−f** *n*] [**−T***tty_type*] [**−−**] [*files*] [**−**]

−d *xy*	sets delimiters to *x* and *y*
−p *n*	changes point size factor *n* of subscripts and superscripts
−s *n*	changes point size to *n*
−f *n*	uses font number *n*
−T*tty_type*	formats for device *tty_type*
−−	delimits the end of options
−	reverts to the standard input

(Also, see **neqn** in this section and information about **eqn** in "Preprocessor Commands and Macros.")

---

grap typesets graphs

grap [**−l**] [**−−**] [*files*] [**−**]

−l does not load the standard define file from **/usr/lib/grap.define**

−− delimits the end of options

− reverts to the standard input

---

hyphen finds hyphenated words

hyphen [*files*] [**−**]

− reverts to the standard input

---

macref produces a cross reference listing of macro files

macref [**−t**] [**−s**] [**−n**] [**−−**] *file*

−t prints macro table of contents

−s prints symbol-use statistics

−n causes one line to be output for each reference to a symbol

−− delimits the end of options

---

mm calls **nroff** to format files containing **mm** macros. (The following printer options also work with the **nroff** command except where noted. Check with your local system administrator about any special printers.)

mm [**−e**] [**−r***An*] [**−t**] [**−c**] [**−E**] [**−12**] [**−T***tty_type*] [*files*] [**−**]

−e causes **nroff** to call **neqn**; also causes **neqn** to read the **/usr/pub/eqnchar** file

−r*An*	sets register *A* to *n*
−t	calls **tbl**
−c	calls **col** (see **col(1)** in the *UNIX System V User's Reference Manual*)
−E	calls the **−e** option of the **nroff** formatter
−12	uses the 12-pitch mode; the pitch switch on the terminal should be set to 12 if necessary
−T*tty_type*	prepares output for device *tty_type*. Legal values of *tty_type* include:

2631	Hewlett-Packard 2631 printer in regular mode
2631-c	Hewlett-Packard 2631 printer in compressed mode
2631-e	Hewlett-Packard 2631 printer in expanded mode
300	DASI-300 printer
300-12	DASI-300 terminal set to 12-pitch (12 characters per inch)
300s	DASI-300s printer (300S is a synonym)
300s-12	DASI-300s printer set to 12-pitch (12 characters per inch) (300S-12 is a synonym)
37	Teletype Model 37 terminal (default for the **nroff** command)
382	DTC-382
4000a	Trendata 4000a terminal (4000A is a synonym)
450	DASI-450 (Diablo Hyterm) printer
450-12	DASI-450 terminal set to 12-pitch (12 characters per inch)
832	Anderson Jacobson 832 terminal
8510	C.ITOH printer
lp	generic name for printers that can underline and tab. (All text using reverse linefeeds, such as those having tables, that is sent to **lp** must be processed with **col**.)

	tn300	GE Terminet 300 terminal
	X	printers equipped with TX print train
		(Check with your system administrator for a list of locally supported devices.)
–		reverts to the standard input

---

mmt	calls **troff** to typeset documents containing **mm** macros
	mmt [**–e**] [**–r***An*] [**–t**] [**–p**] [**–g**] [**–T***tty_type*] [**–D***dest*] [**–a**] [**–z**] [*files*] [**–**]
–e	calls **eqn**; also causes **eqn** to read the **/usr/pub/eqnchar** file
–r*An*	sets register *A* to *n*
–t	calls **tbl**
–p	calls **pic**
–g	calls **grap** (which calls **pic**)
–T*tty_type*	creates output for device *tty_type*. Supported values for *tty_type* are:

aps	creates output for an Autologic APS-5 phototypesetter
i10	creates output for an Imagen Imprint-10 laser printer

−D*dest* directs output to **troff** device *dest*. Supported values for *dest* are:

4014	directs output to a TEKTRONIX 4014 terminal
i10	directs output to an Imagen Imprint-10 laser printer

−a	calls the **−a** option of **troff**
−z	invokes no output filter to process or redirect the output of **troff**
−	reverts to the standard input

---

mvt calls **troff** to typeset view graphs and slides containing **mv** macros

mvt [−e] [−t] [−p] [−g] [−a] [−T*tty_type***] [−D***dest***] [−z] [−p] [***troff options***] [***files***] [−]**

−e	calls **eqn** and has it read the **/usr/pub/eqnchar** file
−t	invokes **tbl**
−p	invokes **pic**
−g	invokes **grap** (which calls **pic**)
−a	directs output to your terminal using the **−a** option of **troff**

−T*tty_type* creates output for device *tty_type*. Supported values for *tty_type* are:

4014	creates output for a TEKTRONIX 4014 terminal

−D*dest* directs output to **troff** device *dest*. Supported values for *dest* are:

4014	directs output to a TEKTRONIX 4014 terminal
−z	does not direct output to a post processor
−p	invokes **pic**
−	reverts to the standard input
	(Also, see the section titled "**mv** Macros.")

---

ndx creates an index

ndx *subj.file "formatter_command_line"*

subj.file is the edited output from **subj** or a subject file that you create. An example of *formatter_command_line* is:

"mm -rW60 -rN2 *file . . .* **"**

---

neqn translates **neqn** control lines into code that **nroff** can use to format mathematical symbols

neqn (see **eqn** above)

---

nroff formats text for typewriter-like terminals

nroff [**−o***list*] [**−n***n*] [**−s***n*] [**−r***An*] [**−i**] [**−q**] [**−z**] [**−m***name*] [**−T***tty_type*] [**−e**] [**−h**] [**−u***n*] [*files*] [**−**]

−o*list*	prints only pages whose page numbers you give in *list;* separate page numbers or page ranges in the *list* with commas (e.g., 3,7-10)
−n*n*	numbers first generated page *n*
−s*n*	stops after every *n* pages
−r*An*	sets register *A* to *n*

−i	reads standard input after *files* are exhausted
−q	invokes simultaneous input-output mode of **.rd**
−z	prints only messages generated by **.tm** requests
−m*name*	uses *name* macro package
−T*tty_type*	prepares output for device *tty_type* (see range of terminal options with **mm** above)
−e	produces equally spaced words in adjusted lines
−h	uses output tabs during horizontal spacing to speed output and reduce output character count
−u*n*	sets emboldening factor for third font position to *n*
−	reverts to the standard input
	(Also, see the "**troff** Characters" section.)

---

pic translates **pic** control lines into code that **troff** can use to draw simple pictures

pic [**−T***tty_type*] [**−−**] [*files*] [**−**]

−T*tty_type*	adapts output for typesetter *tty_type* (see range of typesetter options with **mmt** above)
−−	delimits the end of options
−	reverts to the standard input

---

ptx makes a permuted index

ptx [**−f**] [**−t**] [**−w** *n*] [**−g** *n*] [**−o** *only*] [**−i** *ignore*] [**−b** *break*] [**−r**] [**−−**] [*input*[*output*]] [**−**]

−f	folds uppercase and lowercase letters for sorting
−t	prepares output for phototypesetter
−w *n*	sets width of output line to *n* characters

−g *n*	uses *n* characters to calculate gaps within a line
−o *only*	uses only keywords in *only* file
−i *ignore*	does not use keywords in the *ignore* file
−b *break*	uses characters in *break* file to separate words
−r	serves as a reference identifier

---

subj creates a list of subjects for an index

subj *files*

---

tbl translates **tbl** control lines into code that **nroff** or **troff** can use to format tables

tbl [−TX] [−−] [*files*] [−]

−TX	puts out full vertical line motions only
−−	delimits the end of options
−	reverts to the standard input

(Also, see the section titled "Preprocessor Commands and Macros.")

---

tc interprets files created by **troff** for a TEKTRONIX 4015 terminal (a 4014 terminal with ASCII and APL character sets)

tc [−**t**] [−**o** *list*] [−**a** *n*] [−**e**] [−−] [*file*] [−]

−t	does not wait between pages
−o *list*	prints only the pages that you give in *list;* separate page numbers or page ranges in the *list* with commas (e.g., **3,7-10**)

−a *n*	sets the aspect ratio to *n*
−e	does not erase before each page
−−	delimits the end of options
−	reverts to the standard input

---

troff formats and typesets text

troff [**−o***list*] [**−n***n*] [**−s***n*] [**−r***An*] [**−i**] [**−q**] [**−z**] [**−m***name*] [**−a**] [**−T***tty_type*] [**−F***dir*] [*files*] [**−**]

−o*list*	prints only the pages that you give in *list;* separate page numbers or page ranges in the *list* with commas (e.g., **3,7-10**)
−n*n*	numbers first generated page *n*
−s*n*	stops after every *n* pages
−r*An*	sets register *A* to *n*
−i	reads standard input after *files* are exhausted
−q	invokes simultaneous input-output mode of **.rd**
−z	prints only diagnostics and **.tm** messages
−m*name*	uses macro package *name*
−a	sends printable ASCII approximation to standard output
−T*tty_type*	prepares output for typesetter *tty_type* (see range of typesetters with **mmt** above)
−F*dir*	accesses font information from directory *dir*/**dev***name* instead of the default **/usr/lib/font/dev***name* (where *name* is your system's default output device)
−	reverts to the standard input

(Also, see the section titled "**troff** Characters.")

mm Macros

The **mm** macros are used for memos, articles, research papers, and other standard prose.

Beginning Macros for Formal Memoranda

.ND *date*	new date
.TL [*chg#*] [*file#*]	title follows on next line
.AF [*company-name*]	alternative first-page format
.AU *name* [*initials*] [*loc*] [*dept*] [*ext*] [*room*] [*arg*] ...	author information
.AT *author-title* [...]	title to follow signer's name (up to 9 arguments)
.TM [*number*]	technical memorandum number
.AS [{**0 1 2**}] [*indent*]	abstract start, for technical memorandum and released paper only **0** = abstract on cover sheet and first page **1** = abstract only on cover sheet **2** = abstract only on Memorandum for File cover sheet
.AE	abstract end
.NS	notation start, allowed on Memorandum for File cover sheets following a **.AS 2**/**.AE** macro pair (see the section "Ending Macros" below)
.NE	notation end, allowed on Memorandum for File cover sheets following a **.AS 2**/**.AE** macro pair (see the section "Ending Macros" below)
.OK [*keyword* ...]	other keywords (up to 9 arguments)
.MT [{"" **0 1 2 3 4 5** *string*}] [{*name* **1**}]	document type **0** = "" = no type (internal letter) **1** = memorandum for file **2** = programmer's notes **3** = engineer's notes

4 = released paper
5 = external letter
string = *string* printed
name = addressee's name
(cannot be used with released paper type)
1 = list affiliation of each author
(in released paper style only)

.MT must occur after all cover sheet information

Business Letter Macros

.WA	writer's address start
.WE	writer's address end
.LO CN [*notation*]	confidential notation
.LO RN [*notation*]	reference notation
.IA	inside (recipient's) address start
.IE	inside (recipient's) address end
.LO AT [*notation*]	attention line
.LO SA [*notation*]	salutation
.LO SJ [*notation*]	subject line

.LT [{ none **BL SB FB SP**}]
business letter type
none = Blocked
BL = Blocked
SB = Semiblocked
FB = Full-Blocked
SP = Simplified

Ending Macros (trailing information)

.FC [*closing*]	formal closing

.SG [*initials*] [1] signature line

.NS [{"" **0 1 2 3 4 5 6 7 8 9 10 11 12 13** *string*}]
notation start
"" = Copy to
0 = Copy to
1 = Copy (with att.) to
2 = Copy (without att.) to
3 = Att.
4 = Atts.
5 = Enc.
6 = Encs.
7 = Under Separate Cover
8 = Letter to
9 = Memorandum to
10 = Copy (with atts.) to
11 = Copy (without atts.) to
12 = Abstract Only to
13 = Complete Memorandum to
"*string*" = Copy (*string*) to

.NE notation end

.AV *name* [1] approval signature

.CS [*pgs*] [*other*] [*tot*] [*figs*] [*tbls*] [*ref*]
cover sheet

.TX user exit for table-of-contents titles

.TY user exit for table-of-contents header

.TC [*slev*] [*spacing*] [*tlev*] [*tab*] [*h1*] [*h2*] [*h3*] [*h4*] [*h5*]
table of contents

Paragraphs

.P [{ **0 1 2** }] paragraph
0 = left-justified (default)
1 = indented
2 = indented except after **.H, .LE, .DE**

Section Headings

.H {1 2 3 4 5 6 7} [*heading-text*] [*footnote-mark*]
numbered headings

.HU *heading-text* — unnumbered headings

.HM {1 0001 A a I i} ... — heading mark style
1 = arabic
0001 = arabic with leading 0's
A = uppercase alphabetic
a = lowercase alphabetic
I = uppercase roman
i = lowercase roman

.HX *dlev rlev heading-text* — user exit before headings

.HY *dlev rlev heading-text* — user exit in the middle of headings

.HZ *dlev rlev heading-text* — user exit after headings

Lists

If the last argument [1] is present in the list-start macros, there will be no space between items.

.AL [{1 A a I i}] [*text-indent*] [1]
automatically-incremented list start (1)

.BL [*text-indent*] [1] — start a bullet list

.DL [*text-indent*] [1] — start a dash list

.ML *mark* [*text-indent*] [1] — start a list in which each list item is tagged with *mark*. If *text-indent* is null or omitted it is set to [mark-width+1]

.RL [*text-indent*] [1] — start a reference list

.VL *text-indent* [*mark-indent*] [1]
start a variable tag list

.LI [*mark*] [1] list item follows; 1 means that *mark* is to be prefixed to the current mark

.LE [1] list end; 1 means to output a blank line after list (default: no blank line)

.LB *text-indent mark-indent pad type* [*mark*] [{0 1}] [{0 1}]
list begin
type: 1=. 2=) 3=() 4=[] 5=< > 6={}
6th argument: 0 = no blank line before each list-item
7th argument: 0 = no blank line before list

.LC [*level*] clear list-status up to *level*

Displays, Tables, Equations, and Footnotes

.DS [{0 1 2 3}] [{0 1}] [*n*] or .DS [{L I C CB}] [{ N F }] [*n*]
start static display
L = no indent
I = indent from left
C = center each line
CB = center as a block
N = no-fill
F = fill
n = indent from right *n* spaces

.DF [{ 0 1 2 3 }] [{ 0 1 }] [*n*] or .DF [{ L I C CB }] [{N F }] [*n*]
start floating display;
arguments same as .DS

.DE end display

.FG [*title*] [*override*] [0 1 2] figure caption
0 = prefix with override
1 = suffix
2 = replace

.TS [H] start table;
H = multi page table

.TH [N]	(must be used when specifying argument H to .TS) N = suppress table headers unless on top of new page (Also, see **tbl** in the section "Preprocessor Commands and Macros.")
.TE	end table
.TB [*title*] [*override*] [0 1 2]	table caption
.EX [*title*] [*override*] [0 1 2]	exhibit caption
.EQ [*label*]	start equation display
.EN	end equation display (Also, see **eqn** and **neqn** in the section titled "Preprocessor Commands and Macros.")
.EC [*title*] [*override*] [0 1 2]	equation caption
.FS [*label*]	start footnote
.FE	end footnote
.FD [{0 1 2 3 4 ... 11}] [1]	footnote format 1st argument = set up formatting style for footnote text 2nd argument = reset footnote counter on first-level heading

Page Headers and Footers

.PH "'*left*'*center*'*right*'"	page header
.OH "'*left*'*center*'*right*'"	odd-page header
.EH "'*left*'*center*'*right*'"	even-page header
.PF "'*left*'*center*'*right*'"	page footer

.OF *"'left'center'right'"*	odd-page footer
.EF *"'left'center'right'"*	even-page footer
.BS	bottom-block start
.BE	bottom-block end
.PX	user exit for page-header
.TP	top of page macro

Miscellaneous Macros

.B [*argument*] [*prev-font-argument*]
bold (up to 6 arguments)

.I [*argument*] [*prev-font-argument*]
italic (up to 6 arguments)

.R return to roman font

The following are for alternating fonts and all take 1 to 6 arguments:

.IB	alternate italic and bold
.BI	alternate bold and italic
.RI	alternate roman and italic
.IR	alternate italic and roman
.RB	alternate roman and bold
.BR	alternate bold and roman

.PM [*arg*] proprietary marking

arg	*arg* for (DWB 1.0)	DISCLAIMER MESSAGE
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If you do not give **.PM** an argument, you turn off proprietary markings

.RD [*prompt*] [*diversion*] [*string*]
stop code macro

.RP [{0 1}] [{0 1 2 3}] reference page
1st argument:
0 = reset reference counter (default)
1 = do not reset reference counter
2nd argument:
0 = cause a **.SK** after (default)
1 = do not cause a **.SK** after
2 = do not cause a **.SK** before
3 = do not cause a **.SK** before or after

.RS/.RF automatically numbered references

.WC [{N WF −WF FF −FF WD −WD FB −FB }]
width control for footnotes and displays when using 2 columns:

N	normal mode (**−WF, −FF, −WD**)
WF	footnotes always wide
−WF	footnotes follow page style
FF	first footnote determines width of remaining footnotes on that page
−FF	footnotes follow setting of **WF, −WF**
WD	always wide displays
−WD	displays follow page style
FB	floating display causes break (default)
−FB	floating display does not cause break

.SP [*lines*] skip lines down

.SK [*pages*] skip pages (go to next page)

.OP force odd page start

.2C print output in two columns

.1C print output in one column (normal line width restored)

.SA [*argument*] set right-margin justification
argument = **0** sets default to **off**
argument = **1** sets default to **on**
no *argument* reverts to current default

.SM *string1* [*string2*] [*string3*]
reduce size of *string1* by 1 point if *string3* omitted; otherwise, reduce size of *string2* by 1 point

.HC *c* set hyphenation character to *c*

.S [*point size*] [*vertical spacing*]	set point size and vertical spacing defaults: point size = **10**, vertical spacing=**12p** arguments 1 and 2: *n* = new value ±*n* = increment to current value **D** = default **C** = current value **P** = previous value
.VM [*top*] [*bottom*]	vertical margins
.nP	double-line indent on paragraph start

mm Registers

If an asterisk follows a register name, that register can be set only one of two ways: 1) from the command line (see the **−r** option for **mm** in the section "Alphabetical List of Commands"), or 2) before the formatter reads **mm** macro definitions. In this list, the number shown in parentheses at the end of the line is the default value.

A * handle preprinted forms
Au inhibit author information on first page (1)
C * copy type (Original, DRAFT, etc.) (0)
Cl contents level (2)
Cp placement of figures, tables, equations & exhibits (1)
D * debug flag (0)
De display eject register for floating displays (0)
Df display format register for floating displays (5)
Ds static display pre- & post-space (1)
E * control font of the Subject/Date/From fields
Ec equation counter
Ej page-ejection flag for headings (0)
Eq equation label placement (0)
Ex exhibit counter
Fg figure counter
Fs footnote separation (1)
H1...**H7** heading counters
Hb heading break level (after .H and .HU) (2)
Hc heading centering level for .H and .HU (0)
Hi heading temporary indent (after .H and .HU) (1)
Hs heading space level (after .H and .HU) (2)
Ht heading type: **0** = concatenated numbers,
1 = single numbers (0)
Hu heading level for unnumbered heading (2)
Hy hyphenation control: **0** = no hyphenation (0)
L * length of page (66v)
Le list of equations
Lf list of figures (1)
Li list indent (5 **troff**), (6 **nroff**)
Ls list level down to which there is spacing between items (6)
Lt list of tables (1)
Lx list of exhibits (1)
N * numbering style (0)
Np numbered paragraphs: **0** = unnumbered, **1** = numbered (0)
O * offset of page
Oc page numbering style for table-of-contents:
0 = lowercase roman, **1** = arabic (0)
Of figure caption style (0)
P page number, managed by **mm** (0)
Pi paragraph indent (5)

Ps paragraph spacing (1)
Pt paragraph type (0)
Pv PRIVATE header: **0** = do not print PRIVATE
1 = on first page only,
2 = on all pages (0)
Rf reference counter, used by .RS macro
S * **troff** default point size (10)
Si display indent (5)
T * type of **nroff** output device (0)
Tb table counter
U * underlining style (**nroff**) for **.H** and **.HU** (0)
W * width of page (line and title length)

mm Strings

Print special strings by using the following escape sequences:

*x for strings with single character names (x)
*(xx for strings with two character names (xx)

String Names

BU bullet
Ci indent of heading levels in the table of contents
DT current date
EM em-dash
F footnote numberer
HF heading level font string; **1** = roman,
2 = italic, **3** = bold (2 2 2 2 2 2 2)
HP point sizes of the various heading levels
Le title of the list of equations
Lf title of the list of figures
Lt title of the list of tables
Lx title of the list of exhibits
RE SCCS SID of **mm** macros
Rf reference numberer
Rp title of the reference page
Tm trademark
` grave accent
' acute accent

^ circumflex
~ tilde
: lowercase umlaut
; uppercase umlaut
, cedilla

Reserved Names

If you define your own strings, macros, and registers, only use names that either consist of a single lowercase letter, or of a lowercase letter followed by any character other than a lowercase letter. The names **c2** and **nP** are exceptions to this: they are already used.

mv Macros

The **mv** macros are used for making lecture materials such as view graphs and slides.

Foil-Start Macros

.VS [#] [*who*] [*date*]	Starts a square view graph
.Vw, .Vh, .VW, .VH, .Sw, .Sh, .SW, .SH	Same as **.VS**, except that they start view graphs (**V**) or slides (**S**) that are small wide (**w**), small high (**h**), large wide (**W**), or large high (**H**). Recommended: **.VS** for square view graphs and slides, **.Sw** (and, if necessary, **.Sh**) for 35mm slides.

Level Macros

.A [*no-pre-space*]	return to left margin
.B [*mark* [*size*]]	go to first indent level (default *mark* is large bullet); *s* is point size increment (0)
.C [*mark* [*size*]]	go to second indent level (default *mark* is em-dash)
.D [*mark* [*size*]]	go to third indent level (default *mark* is small bullet)

Text-Control Macros

.T *string*	print *string* as a centered, enlarged title
.I [*in*][*a*[*x*]]	indent all text other than titles by *in*. Takes effect when the next level macro is called. If second argument is given, **.A** is called immediately and the third argument is passed to it.

.S [*size*][*line*]	change point size and/or line length. The first argument has the same effect as the first argument to the **mm** macro of the same name. The second argument sets the line length.
.U *string1* [*string2*]	literally underline *string1* and concatenate *string2* to it. Not recommended.

Default-Setting Macros

.DV [*a*[*b*[*c*[*d*]]]]	set the amount of prespace for level macros. Arguments must be scaled. Default values are .5v, .5v, .5v, 0v.
.DF [*n name*]...	set font positions: takes up to four pairs of arguments of the form "2 I", etc. Must precede the first break in the input file (1 H 2 I 3 B 4 S).

Miscellany

The **mv** package accepts the following uppercase synonyms for the corresponding lowercase **troff** requests:

.AD, .BR, .CE, .FI, .HY, .NA, .NF, .NH, .NX, .SO, .SP, .TA, .TI

The **Tm** string produces a trademark symbol.

man Macros

The **man** Macros are used to produce UNIX system manual pages. The *text* argument represents up to six "words"; if null, the entire next input text line is used as *text*. The *in* argument, if omitted, is set to its previous value.

Format Macros

.TH [*t*][*s*][*c*][*n*]	set title and entry heading; *t* = title, *s*=section number *c* = extra commentary, *n* = new manual name
.SH [*text*]	place subhead *text* here
.SS [*text*]	place sub-subhead *text* here
.B [*text*]	make *text* bold
.I [*text*]	make *text* italic
.SM [*text*]	make *text* 1 point smaller than default point size
.RI [*a*][*b*]	concatenate roman *a* with italic *b*; alternate these two fonts up to six arguments; similar macros alternate between any two of roman, italic, and bold: **.IR, .RB, .BR, .IB, .BI**
.P	begin paragraph with normal font, point size, and indent
.HP [*in*]	begin paragraph with hanging indent
.TP [*in*]	begin indented paragraph with hanging tag; next input line is the tag
.IP [*t*][*in*]	same as **.TP** *in* with tag *t*; if *t* is null, begin indented paragraph
.RS [*in*]	increase relative indent (initially zero)
.RE [*k*]	return to *k*th relative indent level
.PM [P N]	proprietary marking P = PRIVATE N = NOTICE without argument, turn off proprietary marking
.DT	restore default tab settings
.PD [*v*]	set interparagraph distance *v* vertical spaces; default is 0.4v in **troff**, 1v in **nroff**

Strings

R	® in **troff**, **(Reg.)** in **nroff**
S	revert to default type size
Tm	trademark

Registers

IN	left margin indent relative to subheads
LL	line length including **IN**
PD	current interparagraph distance

nroff/troff Requests

This section provides easy access to the basic formatting requests of **nroff/troff**. Requests marked with a "†" are those that apply to **troff** only.

Font and Character Size Control

.ps ±*N*	Point size; also \s±*N*.†
.ss *N*	Space-character size set to *N*/36 em.†
.cs*FNM*	Constant character space (width) mode (font *F*).†
.bd *F N*	Embolden font *F* by *N*−1 units.†
.bd S *F N*	Embolden Special Font when current font is *F*.†
.ft *F*	Change to font *F* = *x*, *xx*, or 1-*N*. Also \f*x*,\f(*xx*,\f*N*.
.fp *N F*	Font named *F* mounted on physical position 1≤*N*.

Page Control

.pl ±*N*	Page length.
.bp ±*N*	Begin next page; next page number *N*.
.pn ±*N*	Make next page number *N*.
.po ±*N*	Set page offset.
.ne *N*	Need *N* vertical space (*V* = vertical spacing).
.mk *R*	Mark current vertical place in register *R*.
.rt ±*N*	Return *(upward only)* to marked vertical place.

Text Filling, Adjusting, and Centering

.br	Break.
.fi	Fill output lines.
.nf	No filling or adjusting of output lines.
.ad *c*	Adjust output lines with mode *c*.
.na	No output line adjusting.
.ce *N*	Center following *N* input text lines.

Vertical Spacing

.vs *N*	Vertical base line spacing (*V*).
.ls *N*	Output *N*−1 *V*s after each text output line.
.sp *N*	Space vertical distance *N* in either direction.
.sv *N*	Save vertical distance *N*.
.os	Output saved vertical distance.
.ns	Turn no-space mode on.
.rs	Restore spacing; turn no-space mode off.

Line Length and Indenting

.ll ±*N*	Line length.
.in ±*N*	Indent.
.ti ±*N*	Temporary indent.

Macros, Strings, Diversions, and Position Traps

.de *xx yy*	Define or redefine macro *xx*; end at call of *yy*.
.am *xx yy*	Append to a macro.
.ds *xx string*	Define a string *xx* containing *string*.
.as *xx string*	Append *string* to string *xx*.
.rm *xx*	Remove request, macro, or string.
.rn *xx yy*	Rename request, macro, or string *xx* to *yy*.
.di *xx*	Divert output to macro *xx*.
.da *xx*	Divert and append to *xx*.
.wh *N xx*	Set location trap; negative is with respect to page bottom.
.ch *xx N*	Change trap location.
.dt *N xx*	Set a diversion trap.
.it *N xx*	Set an input-line count trap.
.em *xx*	End macro is *xx*.

Number Registers

.nr *R* ±*N M*	Define and set number register *R*; auto-increment by *M*.
.af *R c*	Assign format to register *R* (*c*=**1, i, I, a, A**).
.rr *R*	Remove register *R*.

Tabs, Leaders, and Fields

.ta *Nt* ...	Tab settings; *left* type, unless *t*=**R** (right), **C** (centered).
.tc *c*	Tab repetition character.
.lc *c*	Leader repetition character.
.fc *a b*	Set field delimiter *a* and pad character *b*.

Input and Output Conventions and Character Translations

.ec *c*	Set escape character.
.eo	Turn off escape character mechanism.
.lg *N*	Ligature mode on if *N*>0.
.ul *N*	Underline (italicize in **troff**) *N* input lines.
.cu *N*	Continuous underline in **nroff**; like **ul** in **troff**.
.uf *F*	Underline font set to *F* (to be switched to by **ul**).
.cc *c*	Set control character to *c*.
.c2 *c*	Set no-break control character to *c*.
.tr *abcd....*	Translate *a* to *b*, etc., on output.

Hyphenation

.nh	No hyphenation.
.hy *N*	Hyphenate; *N* = mode.
.hc *c*	Hyphenation indicator character *c*.
.hw *word1* ...	Exception words.

Three Part Titles

.tl *'left'center'right'* Three part title.
.pc *c* Page number character.
.lt ±*N* Length of title.

Output Line Numbering

.nm ±*N M S I* Number mode on or off; set parameters.
.nn *N* Do not number next *N* lines.

Conditional Acceptance of Input

.if *c anything* If condition *c* true, accept *anything* as input, for multi-line input use \{*anything*\}.
.if !*c anything* If condition *c* false, accept *anything*.
.if *N anything* If expression $N > 0$, accept *anything*.
.if !*N anything* If expression $N \leqslant 0$, accept *anything*.
.if *'string1'string2' anything*
If *string1* identical to *string2*, accept *anything*.
.if !*'string1'string2' anything*
If *string1* not identical to *string2*, accept *anything*.
.ie *c anything* If portion of if-else; all above forms (like **if**).
.el *anything* Else portion of if-else.

Environment Switching

.ev *N* Switch environment (*push down*).

Insertions from the Standard Input

.rd *prompt* Read insertion.
.ex Exit from **nroff/troff**.

Input/Output File Switching

.so *filename*	Switch source file *(push down).*
.nx *filename*	Next file.
.cf *filename*	Copy file.
.lf *N filename*	Change line number and file name.
.pi *program*	Pipe output to *program.*

Miscellany

.mc *c N*	Set margin character *c* and separation *N.*
.tm *string*	Print *string* on terminal (UNIX standard message output).
.ig *yy*	Ignore till call of *yy.*
.pm *t*	Print macro names and sizes; if *t* present, print only total of sizes.
.fl	Flush output buffer.
.ab *text*	Suppress output but not error messages.
.sy *cmd args*	*cmd* executed but messages not put on standard output.

Preprocessor Commands and Macros

The following is a quick reference to the preprocessors, **tbl**, **eqn**, **neqn**, and **pic**.

tbl

Input Format

[{.DS .DF}]
.TS
options ;
format .
data
.TE
[.DE]

If you include short tables in an **mm** document, you should enclose them within the macro pair **.DS** (or **.DF**) and **.DE**.

Options

center	center
expand	expand to line length
box	enclose in a box
allbox	box all entries
doublebox	enclose in two boxes
tab(*c***)**	change tab character to *c*
linesize(*n***)**	make all lines of thickness *n* points
delim(*xy***)**	recognize *x* and *y* as **eqn** delimiters
;	end of options

Format

l or L	left-adjusted column
r or R	right-adjusted column
c or C	centered column
n or N	numerically-aligned column
a or A	left-adjusted subcolumn
s or S	horizontally spanned item
t or T	push vertical span to top
v or V	vertical line spacing
^	vertically spanned item
u or U	move item ½ line up
z or Z	zero-width item
_	horizontal line
=	double horizontal line
|	vertical line
||	double vertical line
b or B	boldface item
i or I	italic item
f*c* or F*c*	font change to font *c*
p*n* or P*n*	point-size change to size *n*
w(*n*) or W(*n*)	column width minimum = *n*
nn	spaces between columns
e or E	equal-width columns
	end of format

Data

T{...T}	text block Text blocks are used like this: *data*<TAB>**T{** *text block* **T}**<TAB>*data*
_	short horizontal line
\R*x*	repeat *x* across column
\^	above item spans downward into this row
.T&	start new format
.TS H, .TH, and .TE	a variation of the table start/end macros that allows multi-page tables with column headings repeated on each page (this is a feature of the **mm** macros). (See the section titled "**mm** Macros.")

eqn and neqn

Input Format

Displayed Equations:	*In-line Equations:*
.DS (*or* **.DF**) **.EQ** *equation* **.EN** **.DE**	If you specify **.EQ** **delim ##** **.EN** then the text may contain **#** *equation* **#**

If you include displayed equations in an **mm** document, you should enclose them in the macro pair **.DS** (or **.DF**)/**.DE**.

Keywords

sub sup over sqrt

~ ^

... from ... to ...
left { [| (brackets right }] |) brackets
pile { ... above ... }
lpile cpile rpile

dot dotdot hat bar
tilde under vec dyad
roman italic bold fat
font *f* gfont *f*
delim define ndefine

mark lineup

up down fwd back
matrix { col { ... above ... } col { ... above ... } },
lcol ccol rcol
sum int integral prod
union inter

>= <= != == +-
-> <- >> << approx

sin cos tan tanh sinh cosh

for if

arc times lim
max min
log ln exp
prime cdot del half

,..., , ...
uppercase and lowercase Greek

infinity inf
partial grad nothing

Symbols defined in /usr/pub/eqnchar

ciplus	⊕	‖	‖	*square*	□
citimes	⊗	*langle*	⟨	*circle*	○
wig	~	*rangle*	⟩	*blot*	■
−wig	≃	*hbar*	ℏ	*bullet*	•
>wig	≳	*ppd*	⊥	*prop*	∝
<wig	≲	<->	↔	*empty*	∅
=wig	≅	<=>	⇔	*member*	∈
star	⋆	|<	⋖	*nomem*	∉
bigstar	✱	|>	⋗	*cup*	∪
=dot	≐	*ang*	∠	*cap*	∩
orsign	∨	*rang*	∟	*incl*	⊆
andsign	∧	*3dot*	⋮	*subset*	⊂
=del	≙	*thf*	∴	*supset*	⊃
oppA	∀	*quarter*	¼	*!subset*	⊈
oppE	∃	*3quarter*	¾	*!supset*	⊉
angstrom	Å	*degree*	°	*scrL*	ℓ
=-=<	≦	=-=>	≧		

pic

Pictures

The top-level object in **pic** is the "picture":

picture:
.PS *optional-width optional-height*
element-list
.PE

If *optional-width* is present, the picture is made that many inches wide, regardless of any dimensions used internally. The height is scaled in the same proportion unless *optional-height* is present.

If **.PF** is used instead of **.PE**, the position after printing is restored to what it was upon entry.

Elements

An *element-list* is a list of elements; the elements are

shape attribute-list
placename : *element*
placename : *position*
variable = *expression*
direction
{ *list of elements* }
[*list of elements*]
for statement
if statement
copy statement
print statement
plot statement
sh X *commandline* X
troff-command

Specify a *placename* with a capital letter
followed by zero or more letters or numbers.

Specify a *variable* with a letter
followed by zero or more letters or numbers.

Elements in a list must be separated by newlines or semicolons; a long element may be continued by ending the line with a backslash. Comments are introduced by a # and terminated by a newline.

Variable names begin with a lower case letter; place names begin with upper case. Place and variable names retain their values from one picture to the next.

The current position and direction of motion are saved upon entry to a {...} block and restored upon exit.

Elements within a block enclosed in **[...]** are treated as a unit; the dimensions are determined by the extreme points of the contained objects. Names, variables, and direction of motion within a block are local to that block.

troff-command is any line that begins with a period. Such lines are assumed to make sense in the context where they appear.

Primitives

The primitive objects are

primitive:
box
circle
ellipse
arc
line
arrow
spline
move
text-list

arrow is a synonym for **line** −>.

Attributes

An *attribute-list* is a sequence of zero or more attributes; each attribute consists of a keyword, perhaps followed by a value. In the following, *e* is an expression and *opt-e* an optional expression.

attribute:

h(eigh)t *e*	**wid(th)** *e*
rad(ius) *e*	**diam(eter)** *e*
up *opt-e*	**down** *opt-e*
right *opt-e*	**left** *opt-e*
from *position*	**to** *position*
at *position*	**with** *corner*
by *e, e*	**then**
dotted *opt-e*	**dashed** *opt-e*
chop *opt−e*	−> <− <−>
invis	**same**
text-list	

Missing attributes and values are filled in from defaults. Not all attributes make sense for all primitives; irrelevant ones are silently ignored. These are the currently meaningful attributes:

box:
height, width, at, same, dotted, dashed, invis, *text*
circle, ellipse:
radius, diameter, height, width, at, same, invis, *text*
arc:
up, down, left, right, height, width, from, to, at, radius, invis, cw, <–, –>, <–>, *text*
line, arrow:
up, down, left, right, height, width, from, to, by, then, at, same, dotted, dashed, invis, <–, –>, <–>, *text*
spline:
up, down, left, right, height, width, from, to, by, then, at, same, invis, <–, –>, <–>, *text*
move:
up, down, left, right, to, by, same, *text*
text-list:
at, *text-item*

The attribute **at** implies placing the geometrical center at the specified place. For lines, splines and arcs, **height** and **width** refer to arrowhead size.

Text

Text is normally an attribute of some primitive; by default it is placed at the geometrical center of the object. Stand-alone text is also permitted. A *text-list* is a list of text items; a text item is a quoted string optionally followed by a positioning request:

text-item:
"..."
"..." **center**
"..." **ljust**
"..." **rjust**
"..." **above**
"..." **below**

If there are multiple text items for some primitive, they are centered vertically except as qualified. Positioning requests apply to each item independently.

Text items can contain **troff** commands for size and font changes, local motions, etc., but make sure that these are balanced so that the entering state is restored before exiting.

Positions and Places

A position is ultimately an *x,y* coordinate pair, but it may be specified in other ways.

position:
place
(*position*)
expression, expression
(*position*) [± (*expression, expression*)]
(*position*) [± *expression, expression*]
(*place1, place2*), i.e., (*place1*.x, *place2*.y)
expression < *position , position* >
expression **[of the way] between** *position* **and** *position*

place:
placename [*corner*]
corner placename
Here
corner **of** *nth shape*
nth shape [*corner*]

A *corner* is one of the eight compass points or the center or the start or end of a primitive.

corner:
.n .e .w .s .ne .se .nw .sw
.t .b .r .l
.c .start .end

Each object in a picture has an ordinal number; *nth* refers to this.

nth:
*n*th
*n*th last

Since **pic** is flexible enough to accept names like **1th** and **3th**, synonyms like **1st** and **3st** are accepted as well.

Variables

The built-in variables and their default values are:

boxwid 0.75	**boxht 0.5**
circlerad 0.25	**arcrad 0.25**
ellipsewid 0.75	**ellipseht 0.5**
linewid 0.5	**lineht 0.5**
movewid 0.5	**movewid 0.5**
arrowwid 0.05	**arrowht 0.1**
textwid 0	**textht 0**
dashwid 0.5	
scale 1	

These may be changed at any time, and the new values remain in force from picture to picture until changed again.

The variables **textht** and **textwid** may be set to any values to control positioning. The width and height of the generated picture may be set independently from the **.PS** line. Variables changed within "[" and "]" revert to their previous value upon exit from the block. Dimensions are divided by **scale** during output.

Expressions

Expressions in **pic** are evaluated in floating point. All numbers representing dimensions are taken to be in inches.

expression:

e + *e*
e − *e*
e * *e*
e / *e*
e % *e* (modulus)
− *e*
(*e*)
variable
number
place **.x**
place **.y**
place **.ht**
place **.wid**
place **.rad**
sin(*e*) **cos**(*e*) **atan2**(*e*,*e*) **log**(*e*) **sqrt**(*e*) **int**(*e*)
max(*e*,*e*) **min**(*e*,*e*) **rand**(*e*)

Logical Operators

pic provides the following operators for logical evaluation:

!	(not)
>	(greater than)
<	(less than)
⩾	(greater than or equal to)
⩽	(less than or equal to)
3&&	(and)
|	(or)
==	(equal to)
!=	(not equal to)

Definitions

The **define** statement is not part of the grammar.

define:

define *name* **X** *replacement text* **X**

Occurrences of **$1, $2,** etc., in *replacement text* will be replaced by the corresponding arguments if *name* is invoked as

name(*arg1, arg2, ...*)

Non-existent arguments are replaced by null strings. *Replacement text* may contain newlines.

copy and copy thru Statements

The **copy** statement includes data from a file or that follows immediately:

copy "*file*"
copy thru *macro*
copy "*file*" **thru** *macro*
copy "*file*" **thru** *macro* **until** "*string*"

The *macro* may be either the name of a defined macro, or the body of a macro enclosed in some character not part of the body. If no filename is given, **copy** copies the input until the next **.PE.**

for Loops and if Statements

The **for** and **if** statements provide for loops and decision-making:

var=*expr* **to** *expr* **by** *expr* **do X** *anything* **X**
if *expr* **then X** *anything* **X else X** *anything* **X**

The **by** and **else** clauses are optional. The *expr* in an **if** may use the usual relational operators or the string tests *str1* == (or !=) *str2*.

Miscellany

The **sh** command executes a command line:

sh X *commandline* **X**

It is possible to plot the value of an expression:

plot *expr opt-format attributes*

The *expr* is evaluated and converted to a string (using the format specification if provided).

The state of fill or no-fill mode is preserved around a picture.

Input numbers may be expressed in E (exponential) notation.

troff Characters

Standard Characters

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
0123456789
$! % & ( ) * + . , : ; / ? = [ ] |
@ # " < > { } ~ ^

Escape Sequences for Special Characters

‘	(open quote)
’	(close quote)
—	\– (minus)
-	\(hy *or* –

—	\(em	•	\(bu	□	\(sq
–	\(ru	¼	\(14	½	\(12
¾	\(34	fi	\(fi	fl	\(fl
ff	\(ff	ffi	\(Fi	ffl	\(Fl
°	\(de	†	\(dg	’	\(fm
¢	\(ct	®	\(rg	©	\(co

\	\e	A	\(*A	↓	\(da
+	\(pl	B	\(*B	×	\(mu
−	\(mi	Γ	\(*G	÷	\(di
=	\(eq	Δ	\(*D	±	\(+−
*	\(**	E	\(*E	∪	\(cu
§	\(sc	Z	\(*Z	∩	\(ca
´	\(aa	H	\(*Y	⊂	\(sb
`	\(ga	Θ	\(*H	⊃	\(sp
_	\(ul	I	\(*I	⊆	\(ib
/	\(sl	K	\(*K	⊇	\(ip
α	\(*a	Λ	\(*L	∞	\(if
β	\(*b	M	\(*M	∂	\(pd
γ	\(*g	N	\(*N	∇	\(gr
δ	\(*d	Ξ	\(*C	¬	\(no
ϵ	\(*e	O	\(*O	∫	\(is
ζ	\(*z	Π	\(*P	∝	\(pt
η	\(*y	P	\(*R	∅	\(es
θ	\(*h	Σ	\(*S	∈	\(mo
ι	\(*i	T	\(*T	|	\(br
κ	\(*k	Υ	\(*U	‡	\(dd
λ	\(*l	Φ	\(*F	☛	\(rh
μ	\(*m	X	\(*X	☚	\(lh
ν	\(*n	Ψ	\(*Q	∣	\(or
ξ	\(*c	Ω	\(*W	○	\(ci
ο	\(*o	√	\(sr	⌠	\(lt
π	\(*p		\(rn	⌡	\(lb
ρ	\(*r	⩾	\(>=	⌡	\(rt
σ	\(*s	⩽	\(<=	⌡	\(rb
ς	\(ts	≡	\(==	⎨	\(lk
τ	\(*t	≃	\(~=	⎬	\(rk
υ	\(*u	~	\(ap	⎪	\(bv
ϕ	\(*f	≠	\(!=	⌊	\(lf
χ	\(*x	→	\(−>	⌋	\(rf
ψ	\(*q	←	\(<−	⌈	\(lc
ω	\(*w	↑	\(ua	⌉	\(rc

ASCII Character Set

In octal code:

000 nul	001 soh	002 stx	003 etx
004 eot	005 enq	006 ack	007 bel
010 bs	011 ht	012 nl	013 vt
014 np	015 cr	016 so	017 si
020 dle	021 dc1	022 dc2	023 dc3
024 dc4	025 nak	026 syn	027 etb
030 can	031 em	032 sub	033 esc
034 fs	035 gs	036 rs	037 us
040 sp	041 !	042 "	043 #
044 $	045 %	046 &	047 '
050 (	051)	052 *	053 +
054 ,	055 -	056 .	057 /
060 0	061 1	062 2	063 3
064 4	065 5	066 6	067 7
070 8	071 9	072 :	073 ;
074 <	075 =	076 >	077 ?
100 @	101 A	102 B	103 C
104 D	105 E	106 F	107 G
110 H	111 I	112 J	113 K
114 L	115 M	116 N	117 O
120 P	121 Q	122 R	123 S
124 T	125 U	126 V	127 W
130 X	131 Y	132 Z	133 [
134 \	135]	136 ^	137 _
140 `	141 a	142 b	143 c
144 d	145 e	146 f	147 g
150 h	151 i	152 j	153 k
154 l	155 m	156 n	157 o
160 p	161 q	162 r	163 s
164 t	165 u	166 v	167 w
170 x	171 y	172 z	173 {
174 |	175 }	176 ~	177 del

In hexadecimal code:

00 nul	01 soh	02 stx	03 etx
04 eot	05 enq	06 ack	07 bel
08 bs	09 ht	0a nl	0b vt
0c np	0d cr	0e so	0f si
10 dle	11 dc1	12 dc2	13 dc3
14 dc4	15 nak	16 syn	17 etb
18 can	19 em	1a sub	1b esc
1c fs	1d gs	1e rs	1f us
20 sp	21 !	22 "	23 #
24 $	25 %	26 &	27 '
28 (	29)	2a *	2b +
2c ,	2d -	2e .	2f /
30 0	31 1	32 2	33 3
34 4	35 5	36 6	37 7
38 8	39 9	3a :	3b ;
3c <	3d =	3e >	3f ?
40 @	41 A	42 B	43 C
44 D	45 E	46 F	47 G
48 H	49 I	4a J	4b K
4c L	4d M	4e N	4f O
50 P	51 Q	52 R	53 S
54 T	55 U	56 V	57 W
58 X	59 Y	5a Z	5b [
5c \	5d]	5e ^	5f _
60 `	61 a	62 b	63 c
64 d	65 e	66 f	67 g
68 h	69 i	6a j	6b k
6c l	6d m	6e n	6f o
70 p	71 q	72 r	73 s
74 t	75 u	76 v	77 w
78 x	79 y	7a z	7b {
7c |	7d }	7e ~	7f del