



PEN PLOTTER MP4000 SERIES

MP4100 / MP4200 / MP4300 / MP4400

MANUAL NO. MP4000-UM-351

COMMAND SET REFERENCE MANUAL

GRAPHTEC CORPORATION

TOKYO, JAPAN

PART 1

GP-GL COMMANDS

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1. DESCRIPTION OF COMMANDS

1-1. Terminology

- HOME position: The origin that is automatically set when the plotter is initialized.
- OFFSET point: A programmed origin which can be set as required by the OFFSET command. It is the same as the HOME position when the plotter is initialized.
- GDU (Graphic Display Unit): The minimum programmable unit. Coordinates are all expressed as integral multiples of this unit. If FACTOR is not activated, the size of a GDU is set at 0.1 mm. However, it can be set to 0.025 mm (bit 8 of the DIP switch 2).
- Plotting area: The area set by specifying LOWER LEFT and UPPER RIGHT.

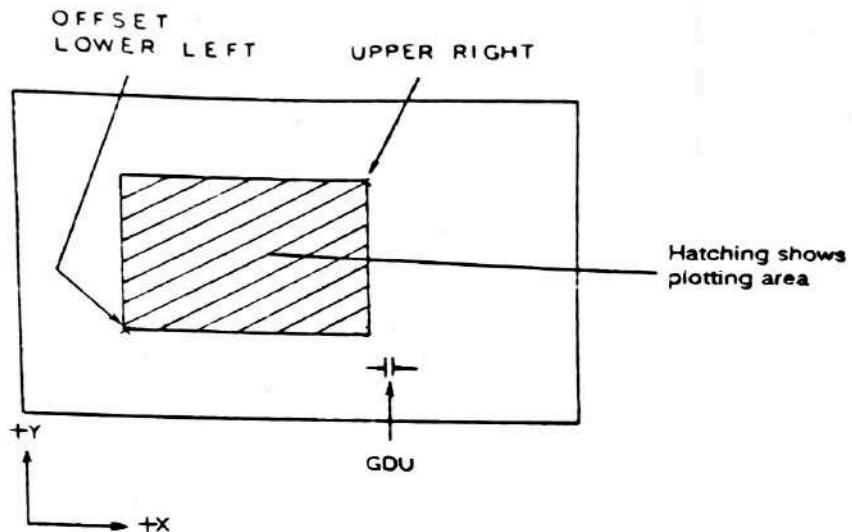


Fig. 1-1-1 Plotting area

- Direct command: A command that is executed immediately it is received by the plotter and is not stored in the buffer memory. CLEAR, INTERFACE CLEAR, READ STATUS WORD 1, and READ STATUS WORD 3 are direct commands.
- Command data byte: Expressed as ASCII characters to indicate the kind of command. This must be put at the beginning of each command. The command data byte is indicated by uppercase letters in the description of each command in this manual.

- Numerical parameters: These are added as parameters such as coordinates, lengths, or number of times for each command. There is no limit on the number of digits in a decimal number, provided that it is within this range. (Note that some numbers have limits on the numerical values of their parameters.)

Table 1-1-1 Parameter ranges

MP4100, 4200

GDU	Parameter ranges		
	Coordinate values, radius of a circle, length of polar coordinates, AXIS length. The difference in the distance between two points.	Character size, spacing, pitch of sloping lines	Angle, FACTOR
0.1 mm	-8191 ~ 8191	0 ~ 8000	-32767 ~ 32767
0.025 mm	-32767 ~ 32767	0 ~ 32000	-32767 ~ 32767

MP4300, 4400

GDU	Parameter ranges		
	Coordinate values, radius of a circle, length of polar coordinates, AXIS length. The difference in the distance between two points.	Character size, spacing, pitch of sloping lines	Angle, FACTOR
0.1 mm	- 2^{23} ~ $2^{23}-1$	0 ~ 8000	- 2^{23} ~ $2^{23}-1$
0.025 mm	- 2^{23} ~ $2^{23}-1$	0 ~ 32000	- 2^{23} ~ $2^{23}-1$

"+" and "-" signs can be used for decimal numbers. If no sign is specified, the number is handled as a positive number. Decimal points and decimal fractions are not regarded as errors, they are just ignored.

Numerical values with no integer part, such as .123, or which include an exponent, such as 123E-1, are not permitted.
Parameters are indicated by lowercase letters in the descriptions of the commands in this manual.

Correct examples 3450, -345, +345

- Character parameters: Character codes which are added to commands as data for the writing of characters, and which are specified as ASCII characters, or JIS 7-bit or 8-bit codes. (See the code charts at the end of this manual for details.)

Examples "A" "1"
 $(41)_{16}$ $(31)_{16}$

- Delimiter:

Always put a delimiter at the end of each numerical parameter to punctuate it. However, in commands like DRAW, RELATIVE DRAW, USER'S PATTERN, CURVE and RELATIVE CURVE, which have a variable number of parameters, it is necessary to put a terminator after the last parameter.

The following can be used as delimiter:

SP (space)
CR (carriage return)
LF (line feed)
. (comma)
+ (plus sign)
- (minus sign)

In the descriptions of the commands in this manual, commas are used as delimiters.

• Terminator:

Indicates the end of a command which has a variable number of parameters (numerical or character). In the initial setting, ETX (the End-of-Text code, 03H) is the terminator. If the ETX code is not received at the end of a command like PRINT, the next command to be received will also be handled as character parameters and written out as characters. In standard BASIC, the terminator is defined as CHR\$(3), but CR (Carriage Return), LF (Line Feed), etc., can also be specified as terminator by the TERM command. Sending another terminator when all the previous commands have ended has no effect.

1-2. Straight line commands (4)

D

DRAW commands: Straight drawing

Command symbol	D (uppercase letter)
Function	Draws a straight line in the absolute coordinate system, with the pen down.
Input format	$Dx_1, y_1, x_2, y_2, \dots, x_n, y_n$ (terminator)
Statement example	LPRINT "D1000, 1000, 1500, 2000"; CHR\$(3)
Parameter range	$-8191 \leq x_i, y_i \leq 8191$ (MP4100, 4200) $-2^{23} \leq x_i, y_i \leq 2^{23}-1$ (MP4300, 4400)
Related commands	L, B
Description	This command draws straight lines, starting from the current position (x_0, y_0) and connecting in succession the coordinates specified by $(x_1, y_1), (x_2, y_2), \dots, (x_n, y_n)$. Express all the coordinates as absolute coordinates. Decimal points and decimal fractions are truncated. Any parameter which exceeds this range, or which is not paired with another to give (x, y) coordinates, is handled as an error. If a specified pair of coordinates is outside the valid plotting area, the pen draws the line up to the edge of the valid plotting area, then rises.

Example

LPRINT #1, "D500, 500, -500, 1000, -500, 2000, 2000, 2500"; CHR\$(3)

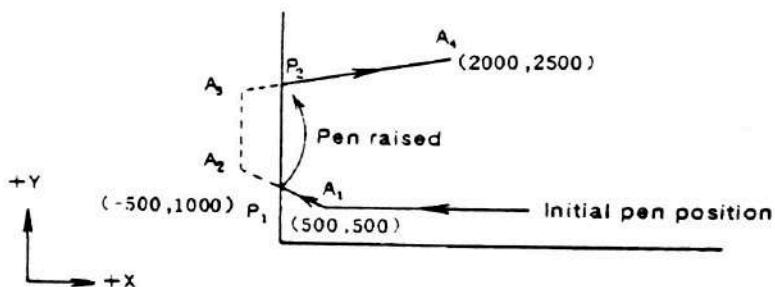


Fig. 1-2-1

If lines connecting **A₁** - **A₂** - **A₃** - **A₄** are specified, but **A₂** and **A₃** happen to be outside the valid plotting area, as shown above, the pen moves along **A₁** - **P₁** - **P₂** - **A₄** without drawing a line from **P₁** - **P₂**.

E

RELATIVE DRAW command: Straight line drawing between relative coordinates

Command symbol	E (uppercase letter)
Function	Draws a straight line in the relative coordinate system from the current pen position, with the pen down.
Input format	$E\Delta x_1, \Delta y_1, \Delta x_2, \Delta y_2, \dots, \Delta x_n, \Delta y_n$ (terminator)
Statement example	LPRINT "E1000, 1000"; CHR\$(3)
Parameter range	$-8191 \leq \Delta x_i, \Delta y_i \leq 8191$ (MP4100, 4200) $-2^{23} \leq \Delta x_i, \Delta y_i \leq 2^{23}-1$ (MP4300, 4400)
Related commands	L, B
Description	<p>This command draws a straight line to the coordinates specified by the displacements $\Delta x, \Delta y$ from the current pen position (x_0, y_0). To connect several coordinates in succession, specify each coordinate point as displacements $(\Delta x, \Delta y)$ from the end of the previous line segment. Express all coordinates as relative coordinates.</p> <p>Decimal points and decimal fractions are truncated.</p> <p>Any parameter which exceeds this range, or which is not paired with another to give (x, y) coordinates, is handled as an error.</p> <p>If a specified pair of coordinates is outside the valid plotting area, the pen draws the line up to the edge of the plotting area, then rises.</p>
Example	LPRINT "E1000, 1000, 1000, -1000, -2000, 0"; CHR\$(3)

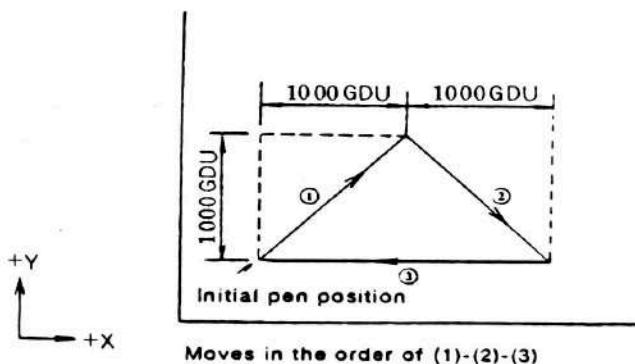


Fig. 1-2-2

M

MOVE command: Movement of raised pen

Command symbol

M (uppercase letter)

Function

Moves the raised pen in the absolute coordinate system.

Input format

Mx, y,

Statement example

LPRINT "M1000, 1000,"

Parameter range

$-8191 \leq x, y \leq 8191$ (MP4100, 4200)

$-2^{23} \leq x, y \leq 2^{23}-1$ (MP4300, 4400)

Description

This command moves the raised pen from its current position (x_0, y_0) to the specified coordinates (x, y).

Express all the coordinates as absolute coordinates. Decimal points and decimal fractions are truncated.

If a series of MOVE commands is input, the pen does not move to each point, only to the point determined to be the final point by the succession of MOVEs.

This command is mainly used for moving the pen to the start of straight lines and characters.

If a specified pair of coordinates is outside the valid plotting area, the pen stops at the edge of the plotting area.

Example

LPRINT "M500, 600,"

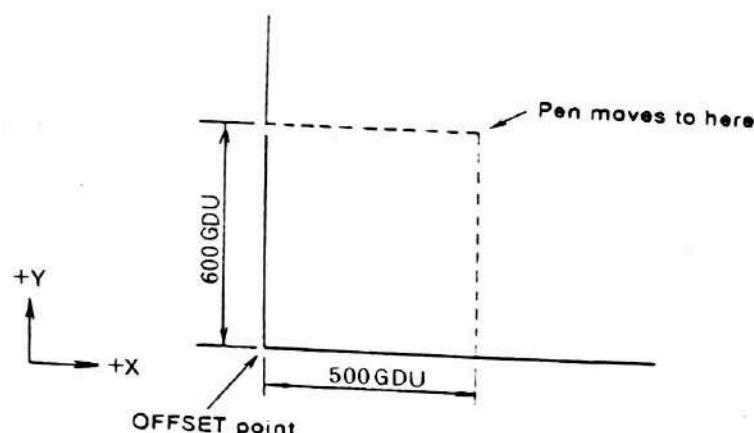


Fig. 1-2-3

O

RELATIVE MOVE command: Movement of raised pen between relative coordinates

Command symbol	O (uppercase letter)
Function	Moves the raised pen in the relative coordinate system.
Input format	O Δ x, Δ y,
Statement example	LPRINT "O1000, 1000,"
Parameter range	$-8191 \leq \Delta x, \Delta y \leq 8191$ (MP4100, 4200) $-2^{23} \leq \Delta x, \Delta y \leq 2^{23}-1$ (MP4300, 4400)
Description	<p>This command moves the raised pen to the coordinates specified by the displacements ($\Delta x, \Delta y$) from the current pen position (x_0, y_0).</p> <p>Express all coordinates as relative coordinates. Decimal points and decimal fractions are truncated.</p> <p>If a series of RELATIVE MOVE commands is given, the pen does not move to each point, it moves directly to the final point determined by the succession of RELATIVE MOVEs (to the point obtained by summing the displacements).</p> <p>If a specified pair of coordinates is outside the valid plotting area, the pen stops at the edge of the plotting area.</p>
Example	LPRINT "O100, 100,"

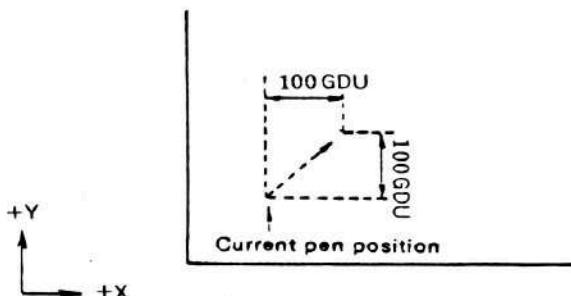


Fig. 1-2-4

1-3. Character and symbol commands (4)

P	PRINT command	Character writing
K	KANA (Greek) command	Character writing

Command symbols

PRINT P
KANA K

Function

Write ASCII, katakana, or Greek characters

Input formats

PRINT $Pc_1c_2 \dots c_n$ (terminator)
KANA $Kc_1c_2 \dots c_n$ (terminator)

Statement examples

LPRINT #1, "PABCD"; CHR\$(3)
LPRINT #1, "K "; CHR\$(3)

Parameter definition

c 10(H) ~ 7E(H)
90(H) ~ FE(H)

Related commands

S, Q, R, I, A, SP, LP

Description

These commands write the ASCII, katakana, and Greek characters which are given as parameters. Use ASCII and JIS 8-bit codes for these parameters.

The characters written by these commands differ according to which FONT command is given, see the code charts at the end of this part for details.

Writing starts from the lower left of the first character the size (ALPHA SCALE), spacing (ALPHA SPACE), rotation (ALPHA ROTATE) and slope (ALPHA ITALIC) of the characters are those specified immediately beforehand. Any respecification of these factors must come before the "P" and "K" commands.

The "P" command and the "K" command can be regarded as the same command with different entrances. The "P" command is initially set on the shift-in (SI) code (0F)₁₆ side, and the "K" command on the shift-out (SO) code (0E)₁₆ side. This means that if an SO code is input while a "P" command is being executed, the character written next will be a katakana character. If a SI code is input, the character written next will be an alphanumeric. When JIS 8-bit code is used, katakana characters are written when B8 = 1 and alphanumerics when B8 = 0, so that a mixture of alphanumeric, katakana and Greek characters is possible during a "P" command.

The same is true for a "K" command, but when the system is set to the SO code side, B8 is always handled as 1 and has no effect.

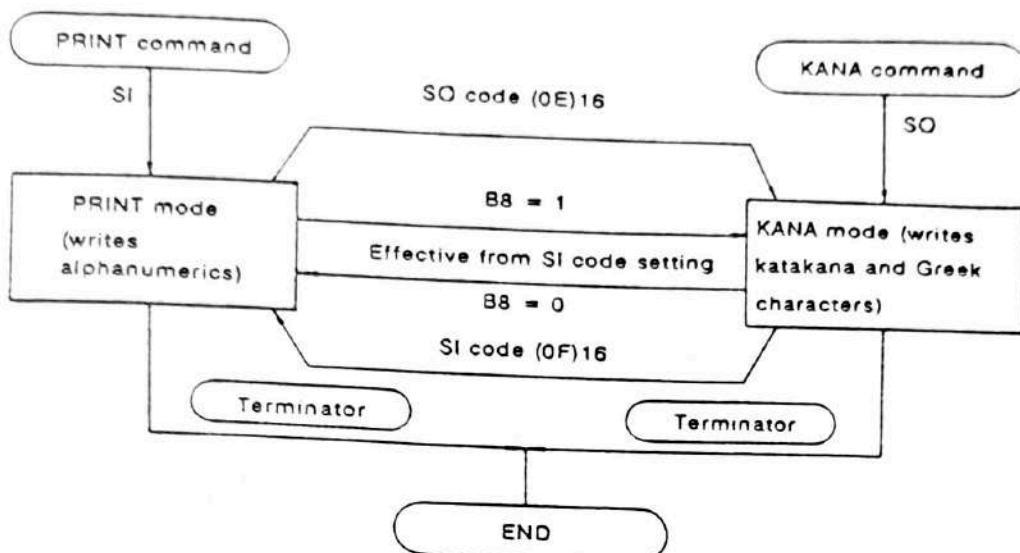


Fig. 1-3-1 Change-over between PRINT and KANA modes

Note: Some alphanumerics and Greek characters extend further downward than others (see the character pattern charts). If those characters are written along the lower border of the valid plotting area, the parts that extend outside the plotting area will be omitted.

Handling of special codes

BS(08H) (Back Space)	The pen back-spaces one character, in the scale and orientation currently specified.
CR(0DH) (Carriage Return)	The pen moves to the lower left corner of the first character in the current line.
LF(0AH) (Line Feed)	The pen position moves down by the specified line spacing, which is 1.5 times the character height set by the ALPHA SCALE command.

Example 1 LPRINT "PABC アイウ"; CHR\$(3)

→ ABC アイウ

Example 2 LPRINT "K123 アイウ"; CHR\$(3)

→ アイウ アイウ

Example 3 LPRINT "PABC"; CHR\$(14); "123"; CHR\$(3)

→ ABC アイウ

Note: CHR\$(14) is the shift-out
(SO) code in BASIC.

Example 4 LPRINT "PABC"; CHR\$(13); CHR\$(10);
"DEF"; CHR\$(3)

→ ABC
→ DEF

Note: CHR\$(13);CHR\$(10) are the
carriage return and line feed (CR,
LF) codes in BASIC.

Table 1-3-1 Character pattern chart (1/4)

32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
			#	\$	%	x		()	*	+	,	-			/
48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
			3	4	5	6	7	8	9	:	:	<	=	>	?
64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79
@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
	Q	B	S			V	W	X	Y	Z					
96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111
	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127
		r	s	t	u	v	w	x	y	z					

Table 1-3-2 Character pattern chart (2/4)

144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159
				H	A	H	O				O	U	Q		
160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175
				.		フ	ア	イ	フ	エ	オ	ヤ	ユ	ヨ	ツ
176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191
				エ	オ	カ	モ	フ	ケ	ロ	サ	シ	ス	セ	ソ
192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207
				ト	ナ	ニ	ヌ	ノ	ハ	ヒ	フ	ヘ	ホ	マ	
208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223
				モ	ヤ	ユ	ミ	リ	ル	レ	コ	フ	ン		
224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239
				ジ	エ	カ	フ	オ	リ	カ	ル	ウ	エ	オ	
240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255
				リ	フ	ク	ウ	ワ	シ	ゼ	+	コ	シ	オ	

Table 1-3-3 Character pattern chart (3/4)

	35	36	64	91	92	93	94	95	123	124	125	126
FONT \$0.	#	\$	@					↔				
FONT \$1.	#	?	@									
FONT \$2.	#	\$	@		¥							
FONT \$3.	#	\$	@									
FONT \$4.		\$	@									
FONT \$5.		\$	S	À	Ö	Ü	Å		ä	ö	ÿ	B
FONT \$6.		\$	à	ó	ç	ş	ş		é	í	ë	œ
FONT \$7.		\$	@	À	Ö	Ü	Å		ä	ö	å	-
FONT \$8.		\$	@	Æ	Ø	Å	Å		æ	ø	å	-
FONT \$9.		\$	@	I	N	J	K		ñ	€	ł	-

Note: Character patterns for these codes depend on the FONT command.

Table 1-3-4 Character pattern (4/4: when FONT\$10, is specified)

160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175
176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191
192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207
	À	ß			—	/	H		K	À	M	N	H	O	
208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223
	P	»		Y	Ø	X	Ψ	Q							
224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239
	a	b	r	ð	E	ç	ñ	θ	l	k	l	u	v	é	o
240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255
π	ø	ø	T	U	ø	X	ψ	W	≤	≥	±	€	©	∞	

N

MARK command: Symbol drawing

Command symbol	N
Function	Draws the symbol specified by parameter n, centered on the current pen position.
Input format	Nn,
Statement example	LPRINT "N3"
Parameter range	0 ≤ n ≤ 15
Related commands	S, R, I
Description	This command draws the symbol specified by parameter n, centered on the current pen position. Parameter n is an integer from 0 to 15, corresponding to one of the symbols below. The pen returns to its initial position after drawing the symbol.

n = 0 Draws nothing.

n = 1 to 15 Draws the corresponding symbol in the size, orientation, and slope specified immediately before by the S, R and I commands.

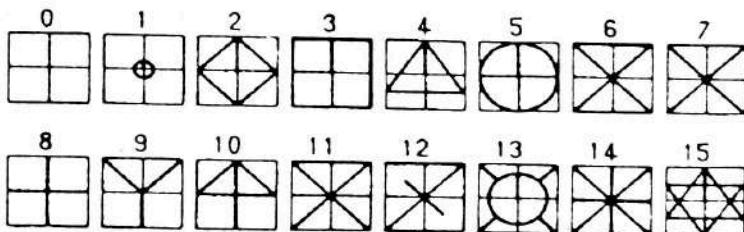


Fig. 1-3-2 Symbol patterns

(P

USER'S PROGRAM PATTERN command: Construction of
user-defined characters

Command symbol

(P

Constructs characters or symbols which are not in the
character code charts.

Function

(P [p] $\Delta x_1, \Delta y_1, [p] \Delta x_2, \Delta y_2, \dots, [p] \Delta x_n, y_n$ (terminator)

Input format

LPRINT "(P 0, 14, 99, 8, 0, -99, -6, 0, 99, 0, -14, -99,
2, 14, 99, 0, -14, -99, 2, 14, 99, 0, -14, -99,
-6, 0, 99, 8, 0"; CHR\$(3)

Statement example

This draws the pattern "III", starting from the current pen
position.

Parameter definitions p:

Pen control parameter. Specifies pen up or down.

p ≥ 99: Pen down

p ≤ -99: Pen up

$\Delta x, \Delta y$: Displacements on a grid for pattern definition. In-
tegers from -98 to +98.

Parameter ranges

-98 ≤ Δx ≤ 98

p ≤ -99, p ≤ 99

-98 ≤ Δy ≤ 98

-127 ≤ $\Delta x_1 + \Delta x_2 + \dots + \Delta x_n$ ≤ 127

-127 ≤ $\Delta y_1 + \Delta y_2 + \dots + \Delta y_n$ ≤ 127

Related commands

S, Q, R, I, A

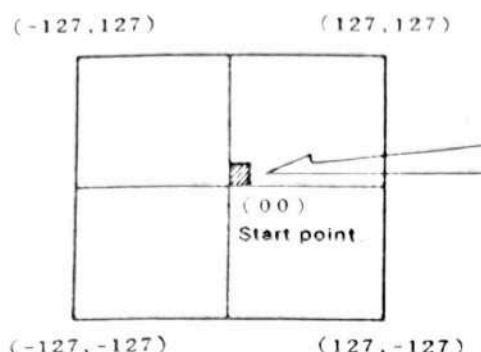
Description

This command enables you to draw characters, symbols,
etc., which are not in the character code charts, by defining
each as a pattern on a grid of up to 254 x 254 points, using
the pen control value p (pen up/down specification) and dis-
placements $\Delta x, \Delta y$.

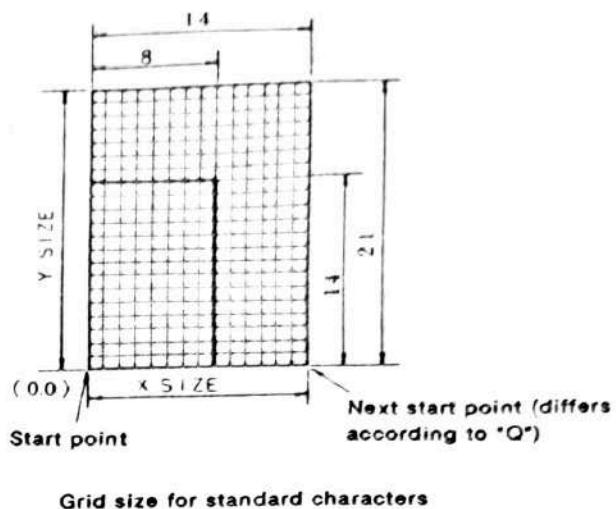
Parameter p indicates whether the pen should be up or
down; the pen is up when p is -99 or less and down when p
is 99 or more. If one of these statuses is specified, it
remains valid until it is respecified, so there is no need to
specify the pen status for each pen movement. When this
command is received, however, the plotter always raises the
pen, so pen-down must be specified once before drawing
the constructed pattern. (When this command is complete,
the pen returns to the status it had before the command was
received.)

$\Delta x, \Delta y$ specify the horizontal and vertical displacements of
the pen, using grid points. Any values within the range of
-98 to 98 can be specified. Decimal points and decimal frac-
tions are ignored.

The grid used for specifying the pen displacements is shown below.



Grid range that can be defined by the "(P" command.



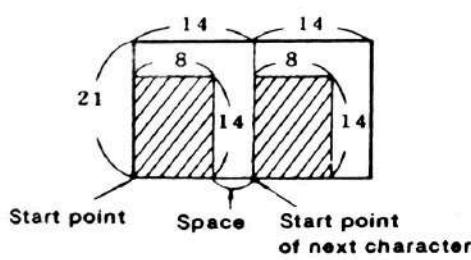
Grid size for standard characters

Fig. 1-3-3

You can construct characters, symbols, etc., by defining patterns within a grid expressed by coordinates from -127 to 127, with the start point of the drawing being considered the origin (0,0). (See the figure above.) Δx and Δy cannot go farther from the origin than the range of -127 to 127. The start point in this case is the point to which the pen moves when the "(P" command is input; this becomes the origin. The point at which the pen actually comes down and starts to draw can be specified freely, provided it is a point on the grid.

The grid for standard characters is 14 x 21 in the initial setting, but in fact each character is constructed on an 8 x 14 grid in the lower left corner of the 14 x 21 grid, with the lower left corner acting as origin. The remaining area provides spacing with respect to the adjacent characters.

This standardization of the size of patterns made using the "(P" command onto the same 8 x 14 grid means that they can be drawn at the same size.



The distance the pen moves after writing a character (that is, the distance to the start point of the next character) is fixed at one character equivalent, as shown in Fig. 1-3-4, unless otherwise specified by the "Q" command. This means that if patterns have been constructed on a larger grid, the characters will overlap unless the pen is moved by a command.

Fig. 1-3-4 Relationship between characters in initial setting

Example

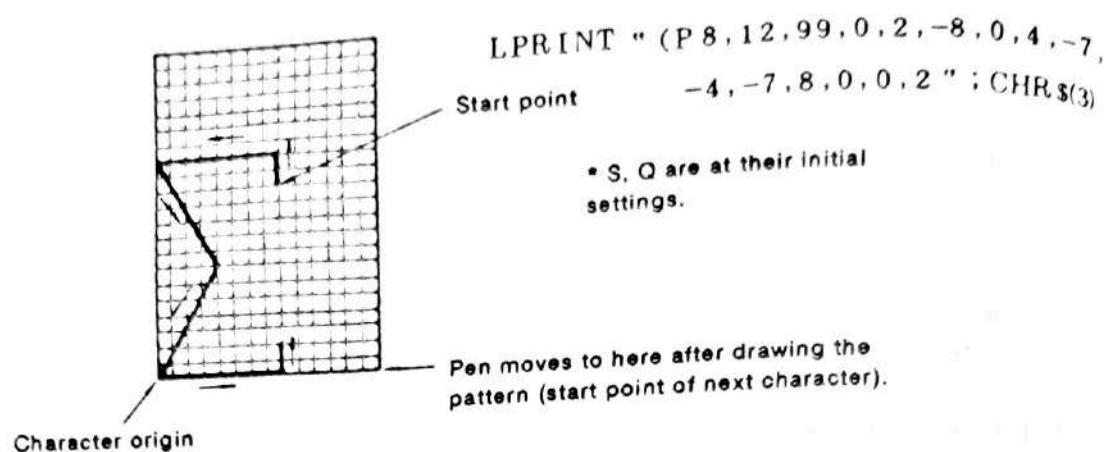


Fig. 1-3-5

1-4. Circle and curve commands (5)

W

CIRCLE command: Drawing of circle, arc, or spiral

Command symbol	W (uppercase letter)
Function	Draws a circle, arc, or spiral.
Input format	$Wx_0, y_0, r_1, r_2, \theta_1, \theta_2 [, d]$ (terminator)
Statement example	LPRINT "W1000, 1000, 500, 500, 0, 3600"; CHR\$(3) This draws a circle of radius 500 units, centered on (1000, 1000).
Parameter definitions	<p>x_0, y_0: Coordinates of center</p> <p>r_1, r_2: Initial and final radii (integral multiples of GDU)</p> <p>θ_1, θ_2: Initial and final angle (integral multiples of 0.1°)</p> <p>d:</p> <ul style="list-style-type: none"> When $d > 0$, d gives the angle subtended by segments of the circle ($d = 100$ gives 10° segments) When $d < 0$, d gives the number of segments of the circle ($d = -5$ divides the circle into 5) When $d = 0$, automatic division is provided.

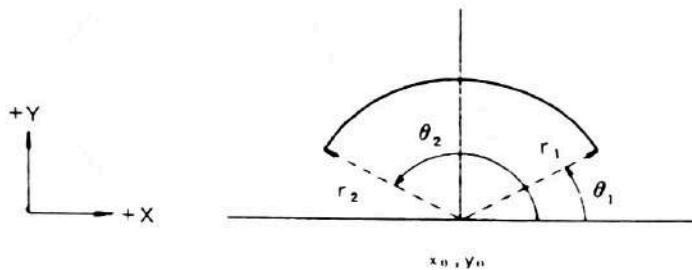


Fig. 1-4-1

Parameter ranges	$-8191 \leq x_0, y_0, r_1, r_2 \leq 8191$ (MP4100, 4200) $-2^{23} \leq x_0, y_0, r_1, r_2 \leq 2^{23}-1$ (MP4300, 4400) $-32767 \leq \theta_1, \theta_2, \theta_1 - \theta_2 \leq 32767$ (MP4100, 4200) $-2^{23} \leq \theta_1, \theta_2, \theta_1 - \theta_2 \leq 2^{23}-1$ (MP4300, 4400) $-8191 \leq d \leq 8191$ (MP4100, 4200) $-2^{23} \leq d \leq 2^{23}-1$ (MP4300, 4400)
Related commands	L, B
Description	This command draws a circle, arc, or spiral of the radii specified by the parameters r_1, r_2 , centered on the coordinates specified by x_0, y_0 . To draw a circle, specify $r_1 = r_2, \theta_1 = 0$, and $\theta_2 = 3600$. A spiral can be drawn by making the values of r_1 and r_2 different.

The drawing is counterclockwise when $\theta_1 < \theta_2$ and clockwise when $\theta_1 > \theta_2$. Angles are measured positively in the counterclockwise direction and negatively in the clockwise direction, from the X-axis.

A polygon can be drawn by specifying the parameter d . This can be done in two different ways, depending on whether d is a positive or negative number.

When d is a positive number, it specifies the angle subtended by segments. For example, $d = 600$ (60°) draws a hexagon.

When d is a negative number, it specifies the number of segments of the circumference of the circle. For example, $d = -6$ divides the circumference into six, to draw a hexagon.

The parameter d can be omitted. When it is omitted, a segment angle that provides a smooth circle is automatically selected.

Example 1 To divide the circumference of a circle into 6

```
LPRINT "W1000 1000, 200, 200, 0, 3600, -6"; CHR$(3)
```

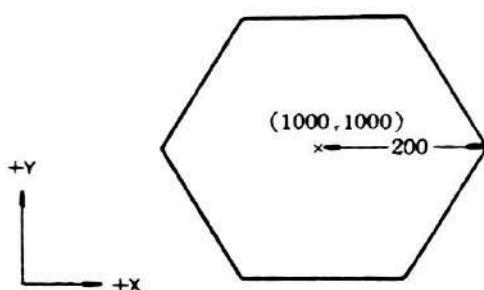


Fig. 1-4-2

Example 2 To draw a spiral

```
LPRINT "W1000, 1000, 200, 0, 7200"; CHR$(3)
```

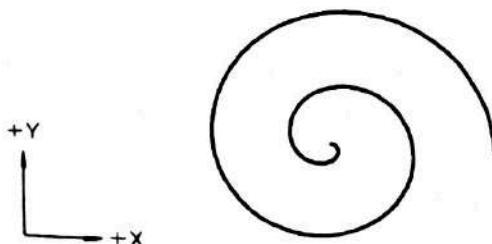


Fig. 1-4-3



RELATIVE CIRCLE command: Drawing of circle, arc, or spiral from current pen position

Command symbol

]

Function

Draws a circle, arc, or spiral, starting from the current pen position.

Input format

] r₁, r₂, θ₁, θ₂ [, d] (terminator)

Statement example

LPRINT "] 500, 500 0, 3600"; CHR\$(3)

This draws a circle of radius 500 units, starting from the current pen position.

Parameter definitions

r₁, r₂: Initial and final radii (integral multiples of GDU)

θ₁, θ₂: Initial and final angle (integral multiples of 0.1°)

d: When d>0, d gives the angle subtended by segments of the circle (d = 100 gives 10° segments)

When d<0, d gives the number of segments of the circle (d = -5 divides the circle into 5)

When d = 0, automatic division is provided.

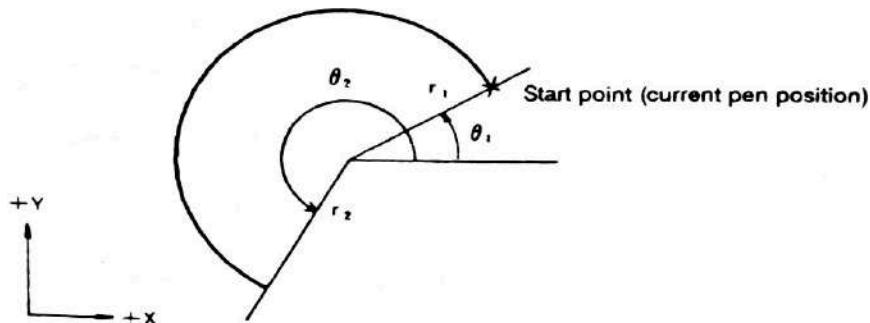


Fig. 1-4-4

Parameter ranges

-8191 ≤ r₁, r₂ ≤ 2²³-1 (MP4100, 4200)

-2²³ ≤ r₁, r₂ ≤ 2²³-1 (MP4300, 4400)

-32767 ≤ θ₁, θ₂, θ₁-θ₂ ≤ 32767 (MP4100, 4200)

-2²³ ≤ θ₁, θ₂, θ₁-θ₂ ≤ 2²³-1 (MP4300, 4400)

-8191 ≤ d ≤ 8191 (MP4100, 4200)

-2²³ ≤ d ≤ 2²³-1 (MP4300, 4400)

Related commands

L, B

Description

This command draws a circle, arc, or spiral, starting from the current pen position. To draw a circle, specify the parameters r₁ = r₂, θ₁ = 0 and θ₂ = 3600. A spiral can be drawn by making the values of r₁ and r₂ different.

The drawing is counterclockwise when θ₁<θ₂, and clockwise when θ₁>θ₂. Angles are measured positively in the counterclockwise direction and negatively in the clockwise direction, from the X-axis.

A polygon can be drawn by specifying the parameter d. This can be done in either of two ways, depending on whether d is a positive or a negative number.

When d is a positive number, it specifies the angle subtended by segments. For example, d = 600 (60°) draws a hexagon.

When d is a negative number, it specifies the number of segments of the circumference of the circle. For example, d = -6 divides the circumference into six, to draw a hexagon.

The parameter d can be omitted. When it is omitted, a segment angle which provides a smooth circle is automatically selected.

A terminator is necessary for this command.

Example To draw a spiral

```
LPRINT "] 200, 0, 0, 7200, -20"; CHR$(3)
```

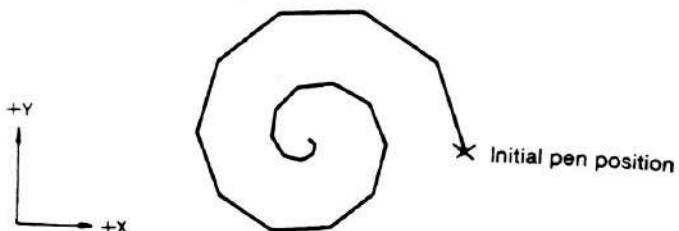


Fig. 1-4-5

NOTE: During the cutter mode, the method by which curved line are processed will vary according to the setting of DIP switch S2-8.

Y

CURVE command: Curve drawing

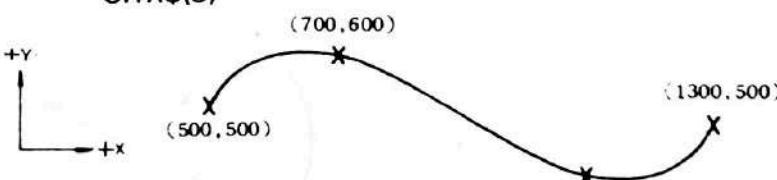
Command symbol	Y (Uppercase letter)
Function	Draws a curve through a string of absolute coordinates.
Input format	Y a, $x_1, y_1, x_2, y_2, \dots, x_n, y_n$ (terminator)
Statement example	LPRINT "Y1, 500, 500, 500 750, 1000, 500, 1000, 750"; CHR\$(3)
Parameter definitions	<p>a = 0: Open curve a = 1: Closed curve x_1, y_1: Start point of curve $x_2, y_2 \dots, x_n, y_n$: Consecutive coordinates of the curve</p>
Parameter ranges	$0 \leq a \leq 1$ $-8191 \leq x_i, y_i \leq 8191$ (MP4100, 4200) $-2^{23} \leq x_i, y_i \leq 2^{23}-1$ (MP4300, 4400)
Related commands	L, B
Description	<p>This command draws a smooth cubic curve through points x_n, y_n given as absolute coordinates. Two types of curve can be selected by parameter a, an open curve is drawn when a = 0, and a closed curve when a = 1.</p> <p>At least three data points are necessary in this command. Do not specify the same point twice in succession in the data, and try to keep each distance between adjacent data points as close to the same value as possible.</p> <p>For a closed curve, it is not necessary to specify the start point again as the end point. The actual start point and end point of the curve is the second point defined.</p> <p>The pen moves raised as far as the start point of the curve.</p> <p>A terminator is necessary at the end of the data.</p>
Example	<pre>LPRINT "Y0, 500, 500, 700, 600, 1100, 400, 1300, 500"; CHR\$(3)</pre> 

Fig. 1-4-6



RELATIVE CURVE command: Curve drawing in relative coordinate system

Command symbol

\leftarrow ("_" in JIS code)

Function

Draws a curve through a string of relative coordinates.

Input format

$\leftarrow a, \Delta x_1, \Delta y_1, \Delta x_2, \Delta y_2, \dots, \Delta x_n, \Delta y_n$ (terminator)

Statement example

LPRINT " $\leftarrow 1, 500, 500, 0, 250, 500, -250, 0, 250$ ";
CHR\$(3)

Parameter definitions

$a = 0$: Open curve
 $a = 1$: Closed curve

$\Delta x_1, \Delta y_1$: Relative displacements from the current pen position to the start point of the curve
 $\Delta x_2, \Delta y_2 \dots, \Delta x_n, \Delta y_n$: Relative displacements of successive points

Parameter ranges

$0 \leq a \leq 1$

$-8191 \leq \Delta x_n, \Delta y_n \leq 8191$ (MP4100, 4200)

$-2^{23} \leq \Delta x_n, \Delta y_n \leq 2^{23}-1$ (MP4300, 4400)

Related commands

L, B

Description

This command draws a smooth cubic curve through points whose coordinates are given by successive relative displacements with respect to the current pen position. Two types of curve can be selected by parameter a , an open curve is drawn when $a = 0$, and a closed curve when $a = 1$.

At least three data points are necessary for this command. Do not specify the same point twice in succession in the data, and try to keep each distance between adjacent data points as close to the same value as possible.

For a closed curve, it is not necessary to specify the start point again as the end point. The actual start point and end point of the closed curve is the second point defined.

A terminator is necessary at the end of the data.

Example

LPRINT " $\leftarrow 1, 100, 100, 0, 250, 500, -250, 0, 250$ ";
CHR\$(3)

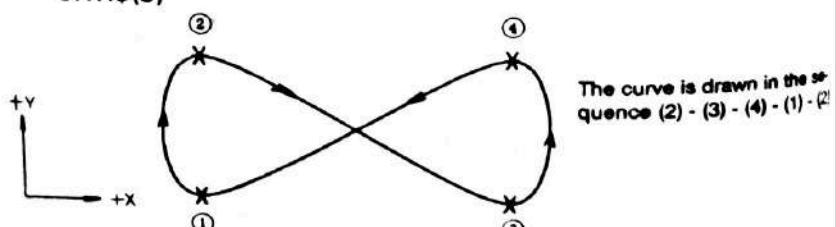


Fig. 1-4-7



ELLIPSE command: Ellipse drawing

Command symbol)
Function	Draws an ellipse.
Input format) a, x ₀ , y ₀ , r ₁ , r ₂ , θ ₁ , θ ₂ , θ ₃ [,d] (terminator)
Statement example	LPRINT ") 0, 1000, 1000, 500, 250, 0, 3600, 450,"
Parameter definitions	<p>a = 0: Moves the raised pen from the current pen position to the start point of the ellipse.</p> <p>a = 1: Moves the lowered pen from the current pen position to the start point of the ellipse.</p> <p>x₀, y₀: Coordinates of the center of the ellipse</p> <p>r₁: Radius of major axis (integral multiple of GDU)</p> <p>r₂: Radius of minor axis (integral multiple of GDU)</p> <p>θ₁, θ₂: Initial and final angles</p> <p>θ₃: Angle between major axis and X-axis</p> <p>d: When d > 0, d gives the angle subtended by segments of the circle (d = 100 gives 10° segments) When d < 0, d gives the number of segments of the circle (d = -5 divides the circle into 5) When d = 0, automatic division is provided.</p>

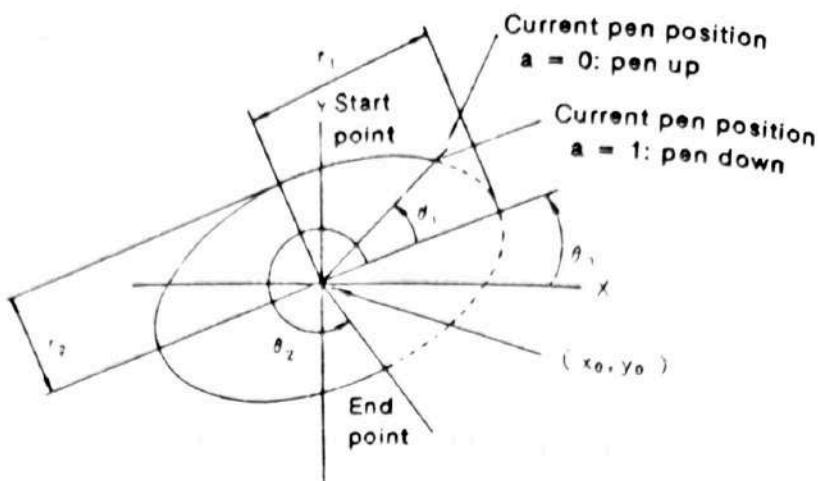


Fig. 1-4-8

Parameter ranges

$-8191 \leq x_0, y_0 \leq 8191$ (MP4100, 4200)

$-2^{23} \leq x_0, y_0 \leq 2^{23}-1$ (MP4300, 4400)

$-8191 \leq r_1, r_2 \leq 8191$ (MP4100, 4200)

$-2^{23} \leq r_1, r_2 \leq 2^{23}-1$ (MP4300, 4400)

$$r_2 < r_1$$

$-3600 \leq \theta_1, \theta_2, \theta_1 - \theta_2 \leq 3600$ (MP4100, 4200)

$-2^{23} \leq \theta_1, \theta_2, \theta_1 - \theta_2 \leq 2^{23}-1$ (MP4300, 4400)

$-3600 \leq \theta_3 \leq 3600$ (MP4100, 4200)

$-2^{23} \leq \theta_3 \leq 2^{23}-1$ (MP4300, 4400)

$-8191 \leq d \leq 8191$ (MP4100, 4200)

$-2^{23} \leq d \leq 2^{23}-1$ (MP4300, 4400)

Description

This command draws an ellipse whose major axis is r_1 and minor axis r_2 , centered on the coordinates (x_0, y_0) .

The inclination of the major axis of the ellipse to the X-axis can be specified by θ_3 when $\theta_1 - \theta_2 = 3600$.

1-5. Character, symbol, and line type commands (9)

L

LINE TYPE command: Line type specification

Command symbol	L (uppercase letter)
Function	Specifies the type of line
Input format	Lp,
Statement example	LPRINT "L2,"
Parameter range	$0 \leq p \leq 8$ Initial setting is $p = 0$
Related commands	D, E, DP, EP, W, Y, ←,)
Description	<p>This command specifies the type of line, which can be selected from the following 9 types.</p> <p>Commands relating to characters and axes are not affected by this command, i.e., K, P, N, (P, X, %).</p> <p>The initial setting is $p = 0$ (solid line). If nothing else is specified, solid lines are drawn. If a parameter other than 0 to 8 is specified, it is ignored and the previously-set value remains valid.</p> <p>Once a parameter is set, the line type selected by it remains valid until it is respecified or the plotter is initialized.</p>

* Parameter ℓ in the following examples is specified by the LINE SCALE command "B". Do not specify $p = 1, 5$ or 7 when using ball-point pens.

Solid line	$P = 0$ 
Dots at regular intervals	$P = 1$ 
1/8 of the pitch is a solid line	$P = 2$ 
1/2 of the pitch is a solid line	$P = 3$ 
25/32 of the pitch is a solid line	$P = 4$ 
Dot-dash line	$P = 5$ 
Long-short dashed line	$P = 6$ 
Double-dot-dash line	$P = 7$ 
Long-short-short dashed line	$P = 8$ 

$$a = \frac{1}{8} \ell, b = \frac{1}{2} \ell, c = \frac{25}{32} \ell, d = \frac{25}{32} \ell, e = \frac{7}{64} \ell, f = \frac{5}{64} \ell, g = \frac{4}{64} \ell, h = \frac{41}{64} \ell$$

Fig. 1-5-1

B

LINE SCALE command: Specification of pitch of broken lines

Command symbol	B (uppercase letter)
Function	Specifies the pitch of broken lines.
Input format	B ℓ ,
Statement example	LPRINT "B80,"
Parameter range	$0 \leq \ell \leq 8191$ (MP4100, 4200) $0 \leq \ell \leq 2^{15}-1$ (MP4300, 4400) Initial setting is $\ell = 100$
Related command	L
Description	This command specifies the pitch of the broken or dotted lines specified by the LINE TYPE command "L". Integers within the range of 0 to 16383 are valid as the parameter. When the parameter is specified so that it is larger than the length of a line to be drawn, the plotter draws a solid line. The initial setting is $\ell = 100$. Once the pitch is set by this command, it remains valid until it is respecified (by a "B" command) or the plotter is initialized.

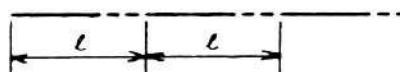


Fig. 1-5-2

S

ALPHA SCALE command: Specification of character and symbol sizes

Command symbol	S
Function	Specifies the size of characters and symbols (marks).
Input format	Sn, [m,]
Statement example	LPRINT "S40,"
Parameter definitions	n: Height (integral multiple of GDU) m: Width (integral multiple of GDU)
Parameter ranges	$0 \leq n \leq 8000$ Initial setting is $n = m = 30$ $0 \leq m \leq 8000$
Related commands	P, K, N, (P
Description	This command specifies the height (m) and width (m) of the characters as integral multiples of the GDU. m can be omitted. When it is omitted, $m = n$ is assumed. This initial setting is $n = m = 30$, where m is the width including a space. When a character size is set by this command, it remains valid until it is respecified or the plotter is initialized. This command influences the commands "K", "P", "(P" and "N".
Example	LPRINT "S100, 200, Q220, PABC"; CHR\$(3)



Fig. 1-5-3

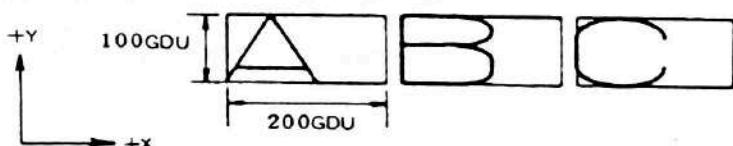


Fig. 1-5-4

Q

ALPHA SPACE command: Specification of character spacing

Command symbol] Q

Function Specifies the spacing between the start point of one character and the start point of the next character.

Input format Q ℓ , [k,]

Statement example LPRINT "Q40,"

Parameter definitions ℓ : Displacement in X-axis direction (measured positively in the +X direction)
 k : Displacement in Y-axis direction (measured positively in the +Y direction)

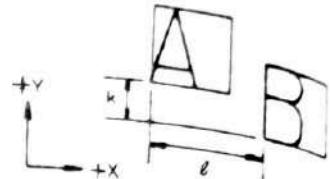


Fig. 1-5-5

Parameter ranges $-8000 \leq \ell \leq 8000$ (Integral multiple of GDU)
 $-8000 \leq k \leq 8000$ (Integral multiple of GDU)

Initial setting is $\ell = 30, k = 0$

Related commands P, K, N, (P

Description This command specifies the spacing between the start point of one character and that of the next along the X- and Y-axes, as integral multiples of the GDU.

If the ALPHA ROTATE command "R" is not specified, parameter ℓ means the displacement in the X-axis direction, and parameter k the displacement in the Y-axis direction.

Note that when an "R" command is issued, the directions of ℓ and k rotate together with the characters.

The ALPHA SPACE command can be used as a simple way of writing characters vertically. For vertical writing, just specify ℓ as 0 and k as a negative number.

Parameter k can be omitted, it is handled as 0 when omitted.

This command affects all the character commands: "K", "P", "(P" and "N".

Example

```
LPRINT "S100,00,-120,PAB"; CHR$(3)
```

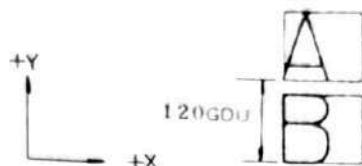


Fig. 1-5-6

R

ALPHA ROTATE command: Rotation of characters

Command symbol

R

Function

Rotates the orientation of characters and character strings

Input format

R θ

Statement example

LPRINT "R300,"

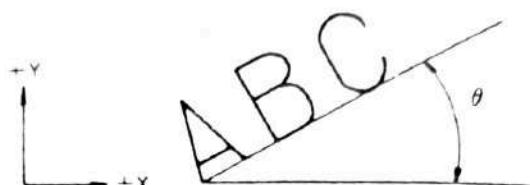


Fig. 1-5-7

Parameter range

$-32767 \leq \theta \leq 32767$ (MP4100, 4200)

$-2^{23} \leq \theta \leq 2^{23}-1$ (MP4300, 4400)

Measured positively in the
counterclockwise direction.
Initial setting is $\theta = 0$.

Related commands

P, K, N, (P

Description

Use this command to rotate characters and character strings.

Parameter θ gives the angle of rotation as an integral multiple of 0.1° . Decimal point and decimal part are truncated.

The angle of rotation is measured positively in the counterclockwise direction and negatively in the clockwise direction, with respect to the X-axis. If not otherwise specified, it is set at 0° .

I

ALPHA ITALIC command: Tilting of characters

Command symbol I

Function Specifies the slope of characters and symbols.

Input format Ip,

Statement example LPRINT "I256, PAB"

Parameter range $-4000 \leq p \leq 4000$
 $p = 256 \tan\theta$

Related commands P, K, (P, N

Description Use this command to draw sloping characters. Unlike the parameters of other commands which specify rotational angles, the parameter of this command is expressed by:

$$p = 256 \tan\theta$$

θ represents the angle of slope of the character with respect to the Y-axis, positively in the clockwise direction and negatively in the counterclockwise direction. Once you decide on the angle of slope of the characters, substitute it into the equation to get the value of parameter p.

For example, to tilt the characters at $= 45^\circ$ to the Y-axis.

$$\begin{aligned} p &= 256 \tan(45^\circ) \\ &= 256 \cdot 1 \\ &= 256 \end{aligned}$$

Therefore parameter p is 256.

* Any decimal point and decimal fraction in the value of p are truncated.

Example

```
LPRINT "I"; 256*TAN (10*3.1415926/180)
LPRINT "Pabc"; CHR$(3)
```

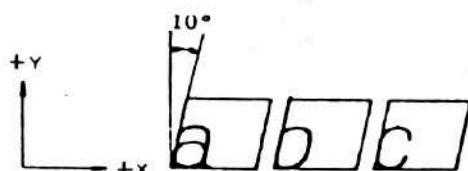


Fig. 1-5-9



FONT command: Character code selection

Command symbol

\$

Function

Selects the code chart for the characters, and sets the resolution of the character patterns to be drawn by "P" and "K" commands.

Input format

\$n, [m,]

Statement example

LPRINT "\$0, 2,"

This selects the STANDARD character codes, and sets the resolution of the curved parts of the characters to twice the initial value.

Parameter ranges

n 0 ~ 99

(See the description for the meaning of each value)

Initial setting is n = 60

m 2^k (k = 0 ~ 5)

(See the description for the meaning of each value)

Initial setting is m = 8

Description

Parameter n of this command selects the code chart for the characters to be written by the "P" and "K" commands. (See the code charts at the end of this manual.)

Table 1-5-1 shows the 12 special characters that can be selected to provide fonts for different countries, by specifying the corresponding value as parameter n.

The writing of katakana characters can be selected, and five different character patterns for 0 (zero) and O (oh) can also be selected.

Table 1-5-1 FONT chart

Parameter (n)	Country	Code position											
		2/3	2/4	4/0	5/B	5/C	5/D	5/E	5/F	7/B	7/C	7/D	7/E
0	STANDARD	*	\$	@	[\]	↑	←	()	-	-
1	ISO	*	□	@	[\]	^	-	()	-	-
2	Japan	*	\$	@	[¥]	^	-	()	-	-
3	U. S. A.	*	\$	@	[\]	^	-	()	-	-
4	Britain	£	\$	@	[\]	↑	-	()	-	-
5	Germany	£	\$	§	À	Ö	Ü	^	-	ä	ö	ü	ß
6	France	£	\$	à	ô	ç	§	^	-	é	ú	é	..
7	Sweden	£	\$	@	Ä	Ö	Å	^	-	å	ö	ä	-
8	Denmark	£	\$	@	Æ	Ø	Á	^	-	æ	ø	å	-
9	Spain	£	\$	@	í	ñ	é	^	-	(ñ)	-

Parameter n has the following meanings:

- A. Selection of katakana characters (select a value of n from these two ranges):
(1) n = 0 - 9

Alphanumerics and symbols are in accordance with the FONT chart. Both katakana and Greek characters are included.

- (2) n = 10 - 19

The same alphanumerics and symbols as those of n = 0 - 9. Katakana characters are not included, but the variety of Greek characters is increased.

- B. Selection of patterns for 0 (zero) and O (oh)
(select the value of n from these five ranges):

		(zero)	(oh)
①	FONT\$ 0 ~ 19		
②	FONT\$ 20 ~ 39		
③	FONT\$ 40 ~ 59		
④	FONT\$ 60 ~ 79		
⑤	FONT\$ 80 ~ 99		

Fig. 1-5-10

In (2)-(5), characters other than 0 (zero) and O (oh) are the same as those for n = 0 - 19.

The resolution of the curved parts of the characters can be specified by the parameter m.

m is expressed as 2^k ($k = 0 - 5$).

In other words, m must be one of 1, 2, 4, 8, 16 or 32. The smaller the value of m, the smoother the curved parts of the characters; but the plotting speed will be slower because the curves are divided into larger numbers of segments. Select a suitable resolution to suit your purpose.

The initial setting is m = 8.

Parameter m can be omitted. If it is omitted, the value set previously remains effective.

m = 1

m = 2

m = 4

m = 8

m = 16

m = 32



Fig. 1-5-11

LP

LABEL POSITION command: Setting of start point of character string

Command symbol

LP (uppercase letters)

Function

Moves the pen to the position specified as the start point of character string writing.

Input format

LPn (terminator)

Statement example

LPRINT "LP3"; CHR\$(3)

(This moves the point at which character writing starts one character equivalent downward.)

Parameter definition

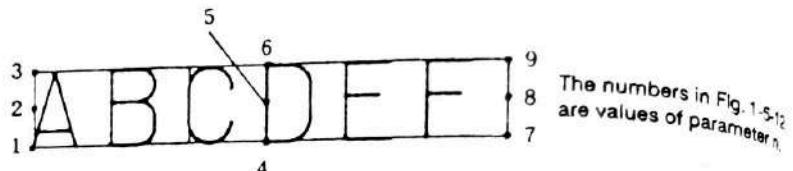


Fig. 1-5-12

This command moves the start point of character writing so that one of the points indicated by the values above becomes the current pen position.

Parameter range

 $1 \leq n \leq 9$ Initial setting is $n = 1$

Related commands

P, K

Description

This command moves the point at which the writing of a character string starts to the position specified by parameter n.

When writing a string of characters, the current pen position usually becomes the lower left point of the first character. But by using this command, you can make the desired point of the character string, specified by n, becomes the current pen position, by automatically moving the position of the character string itself. (Writing still starts from the first character in the string.)

Parameter n is valid within the range of 1 to 9; the initial setting is $n = 1$.

If a value outside this range is specified, it is ignored and $n = 1$ is assumed.

$n = 1 - 3$ specify the beginning of the character string, $n = 4 - 6$ its center, and $n = 7 - 9$ its end, as the current pen position.

$N = 2, 5, \text{ or } 8$ moves the position downward by half a character equivalent, and $n = 3, 6, \text{ or } 9$ moves it by one character equivalent, from the $n = 3, 6, \text{ or } 9$ position, respectively.

The position of the pen after the completion of the drawing is 7 when $n = 1, 4, \text{ or } 7$, 8 when $n = 2, 5, \text{ or } 8$, or 9 when $n = 3, 6, \text{ or } 9$.

All characters written by "P", "K" commands are affected by this command. (However, control characters - CR, LF, BS, etc. - are not included in character strings.)

The characters drawn by "P" command are not affected.

The start point of drawing set by this command remains valid until it is respecified, the "A" command is issued, or the plotter is initialized.

A

ALPHA RESET command: Initialization of character-writing commands

Command symbol

A (uppercase letter)

Function

Initializes the parameters of commands relating to character writing.

Input format

A

Statement example

LPRINT "A"

Description

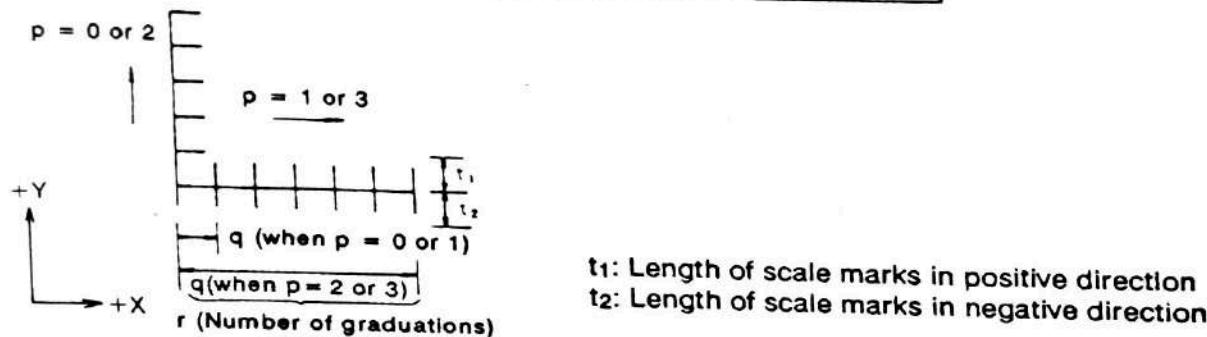
This command returns the parameters of the character and symbol setting commands to the values set by the initialization of the plotter:

FONT	"\$" n = 60, m = 8
ALPHA SCALE	"S" n = 30, m = 30
ALPHA SPACE	"Q" l = 30, k = 0
LAPHA ROTATE	"R" θ = 0
ALPHA ITALIC	"I" p = 0
LABEL POSITION	"LP" n = 1
SELECT POINT MARK	"SP"

1-6. Graph plotting commands (3)

X	AXIS command: Coordinate axis drawing
----------	---------------------------------------

Command symbol	X																				
Function	Draws a coordinate axis and scale lines parallel to either the X- or Y-axis.																				
Input format	Xp, q, r [, t ₁ [, t ₂]] (terminator)																				
Statement example	LPRINT "X1, 100, 10, 0, 10"; CHR\$(3)																				
Parameter definitions	<table border="1"> <thead> <tr> <th>P</th> <th>Axial direction</th> <th>q</th> <th>r</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Y</td> <td>Unit length</td> <td>Number of repeats</td> </tr> <tr> <td>1</td> <td>X</td> <td>Unit length</td> <td>Number of repeats</td> </tr> <tr> <td>2</td> <td>Y</td> <td>Total length</td> <td>Number of divisions</td> </tr> <tr> <td>3</td> <td>X</td> <td>Total length</td> <td>Number of divisions</td> </tr> </tbody> </table>	P	Axial direction	q	r	0	Y	Unit length	Number of repeats	1	X	Unit length	Number of repeats	2	Y	Total length	Number of divisions	3	X	Total length	Number of divisions
P	Axial direction	q	r																		
0	Y	Unit length	Number of repeats																		
1	X	Unit length	Number of repeats																		
2	Y	Total length	Number of divisions																		
3	X	Total length	Number of divisions																		



* When t₁ and t₂ are omitted, or both are 0:
t₁ = t₂ = 10

Fig. 1-6-1

Parameter ranges	$0 \leq p \leq 3$ $-8191 \leq q \leq 8191$ (MP4100, 4200) $-2^{23} \leq q \leq 2^{23}-1$ (MP4300, 4400) $1 \leq r \leq 8191$ (MP4100, 4200) $1 \leq r \leq 2^{23}-1$ (MP4300, 4400) $0 \leq t_1, t_2 \leq 8191$ (MP4100, 4200) $0 \leq t_1, t_2 \leq 2^{23}-1$ (MP4300, 4400)
------------------	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

Description

This command starts drawing from the current pen position. Specify the Y coordinate axis by $p = 0$ or 2 , and the X coordinate axis by $p = 1$ or 3 .

The meanings of parameters q, r depend on the value of p .

When p is 0 or 1 , q specifies the length of a single graduation and r the number of its repeats.

When p is 2 or 3 , q specifies the total length of the coordinate axis and r the number of divisions. Decimal points and decimal fractions in both q and r are truncated.

When q is a positive number, the X-axis is drawn to the right and the Y-axis upward, from the current pen position. When q is a negative number, the X-axis is drawn to the left and the Y-axis downward, from the current pen position.

By specifying t_1 and t_2 , it is possible to change the lengths of scale marks or lines. ($t_1 + t_2 = 20$ is assumed when these parameters are omitted.) Grids and tables can be made by using this function.



HATCHING command (1): Drawing of rectangles and hatching

Command symbol	%
Function	Draws a rectangle parallel to the X- and Y-axes, and hatches inside it.
Input format	%n, x, y, d, θ (terminator)
Statement example	LPRINT "%3, 500, 200, 20, 450"; CHR\$(3) This draws a rectangle of 500 x 200 units, and hatches it with a hatching pattern of a line spacing of 20 at an angle of 45°.
Parameter definitions	<p>n = 1: Rectangle only n = 2: Hatching only n = 3: Rectangle with internal hatching</p> <p>x: Length in X-axis direction (integral multiple of GDU) y: Length in Y-axis direction (integral multiple of GDU) d: Line spacing of hatching (integral multiple of GDU) θ: Angle of hatching from X-axis (integral multiple of 0.1°, measured positively in the counterclockwise direction and negatively in the clockwise direction.)</p>
Parameter ranges	$1 \leq n \leq 3$ $-8191 \leq x, y \leq 8191$ (MP4100, 4200) $-2^{23} \leq x, y \leq 2^{23}-1$ (MP4300, 4400) $0 < d \leq 4000$ (MP4100, 4200) $0 < d \leq 2^{23}-1$ (MP4300, 4400) $-3600 \leq \theta \leq 3600$ (MP4100, 4200) $-2^{23} \leq \theta \leq 2^{23}-1$ (MP4300, 4400)

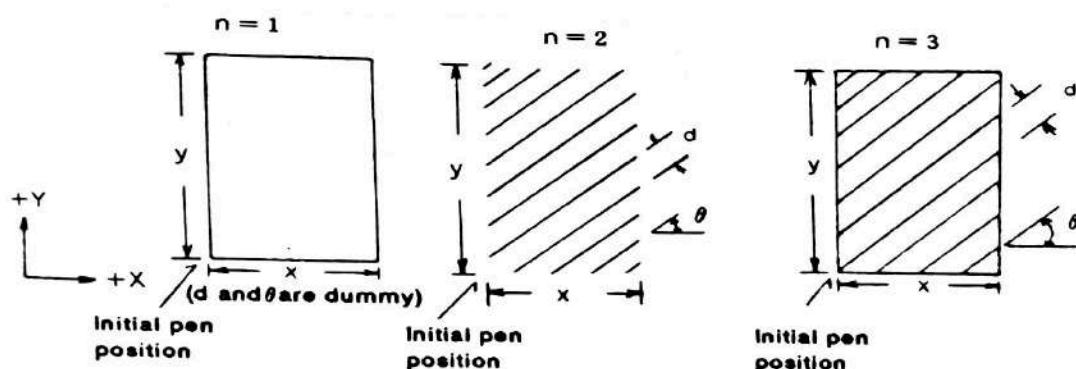


Fig. 1-6-2

Related commands

L, B, ↑P

Description

This command draws a rectangle parallel to the X- and Y-axes, and hatches inside it.

The drawing starts from the current pen position which becomes the lower left corner of the rectangle.

Parameters x and y specify the lengths of the sides of the rectangle in the horizontal and vertical directions, respectively. For hatching, they specify the lengths of the hatched area along the X- and Y-axes. Parameter d specifies the line spacing of the hatching; do not specify it as 0. Note that if this parameter is too large, hatching cannot be drawn within the rectangle.

(To fill in a rectangle completely and neatly when using a fiber-tip pen, specify parameter d as 5 or less.)

Parameter θ specifies the slope of hatching lines as an angle from the X-axis. Specify the angle as an integral multiple of 0.1° , measured positively in the counterclockwise direction.

(When the "↑P" command is executed, this parameter gives the angle from the angle reference set by parameter θ_0 , expressed as an integral multiple of the angle unit set by parameter f.)

Parameters d, θ are ignored when n = 1, but they cannot be omitted because they are necessary as dummy parameters.

Any line type specification by the "L" and "B" commands affects the frame line of the rectangle only, not the hatching lines.

Only the angle parameter is affected by the "↑P" command.

Example

LPRINT "%3, 500, 200, 20, 450"; CHR\$(3)

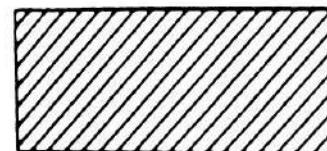


Fig. 1-6-3

%

HATCHING command (2): Hatching of circle or fan shape

Command symbol	%
Function	Draws a fan shape and hatches inside it.
Input format	%n, r ₁ , r ₂ , θ ₁ , θ ₂ , d, θ ₃ (terminator)
Statement example	LPRINT "%13, 200, 500, 0, 450, 20, 450"; CHR\$(3)
Parameter definitions	<p>n = 11: Fan shape only n = 12: Hatching of fan shape only n = 13: Fan with internal hatching</p> <p>r₁: Radius of outer circle of fan (integral multiple of GDU) r₂: Radius of inner circle of fan (integral multiple of GDU) θ₁, θ₂: Range of drawing (between θ₁ and θ₂, expressed as integral multiples of 0.1°) d: Line spacing of hatching (integral multiple of GDU) θ₃: Angle of hatching from X-axis (integral multiple of 0.1°, measured positively in the counterclockwise direction and negatively in the clockwise direction)</p>

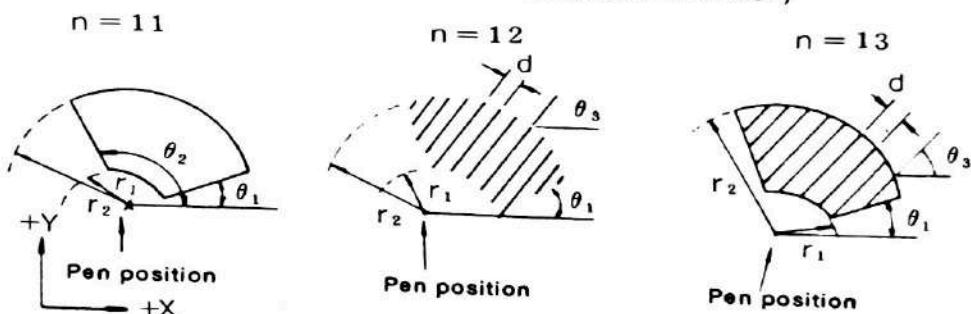


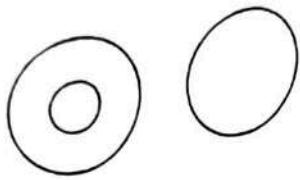
Fig. 1-6-4

Parameter ranges	$0 \leq r_1 \leq 4000, 0 < r_2 \leq 4000, r_1 < r_2$ $-3600 \leq \theta_1, \theta_2, \theta_3 \leq 3600 * \theta_1 - \theta_2 \leq 3600$ (MP4100, 4200) $-2^{23} \leq \theta_1, \theta_2, \theta_3 \leq 2^{23} - 1 * \theta_1 - \theta_2 \leq 2^{23} - 1$ (MP4300, 4400) $0 < d \leq 4000$
------------------	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

Related commands	L, B, ↑P
------------------	----------

Description

This command draws a fan shape centered on the current pen position, and hatches inside it. Specify the size of the outer and inner circles by parameters r_1 and r_2 , respectively. Straight line segments drawn from r_1 to r_2 to close the fan shape are also drawn when full circles are not specified by θ_1 and θ_2 .



Parameter d specifies the line spacing of hatching; do not specify it as 0. Note that if this parameter is too large, hatching cannot be drawn.

(To fill in the fan shape completely, specify parameter d as 5 or less.)

Fig. 1-6-5

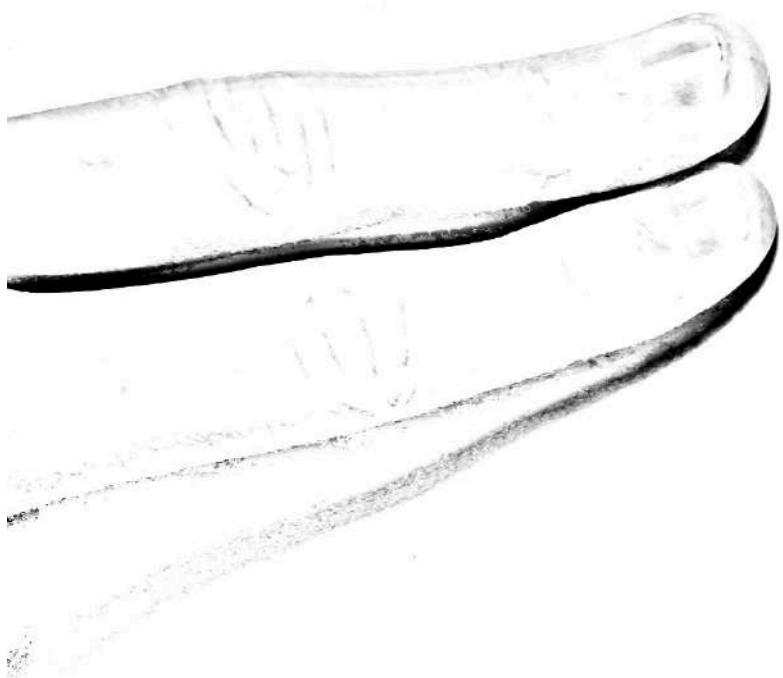
Parameters θ_1 and θ_2 express the range of the fan shape and θ_3 gives the slope of the hatching lines, in integral multiples of 0.1° with respect to the +X-axis direction.

* When the "↑P" command is executed, these parameters give the angle from the angle reference set by parameter θ_0 , expressed as integral multiples of the angle unit specified by parameter f .

Parameters d and θ_3 are ignored when $n = 11$, but they cannot be omitted because they are necessary as dummy parameters.

Any line type specification by the "L" and "B" commands affects the frame lines only, not the hatching lines.

Only the angle parameters are affected by the "↑P" command.





HATCHING command (3): Drawing and hatching of any string of points

Command symbol

%

Function

Draws any desired string of points and hatches inside it.

Input format

%n, d, θ , $x_1, y_1, x_2, y_2, \dots, x_n, y_n$ (terminator)

Statement example

LPRINT "%23, 20, 450, 500, 500, 1500, 500,
1000, 1500"; CHR\$(3)

Parameter definitions

n = 21: Point string only
n = 22: Hatching within point string only
n = 23: Point string with internal hatching
d: Line spacing of hatching (integral multiple of GDU)
 θ : Angle of hatching from X-axis (integral multiple of 0.1°, measured positively in the counterclockwise direction and negatively in the clockwise direction)
 x_n, y_n : Coordinates of points in string (integral multiples of GDU)

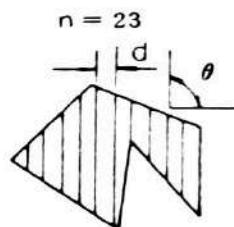
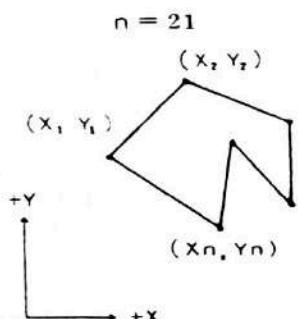


Fig. 1-6-6

Parameter ranges

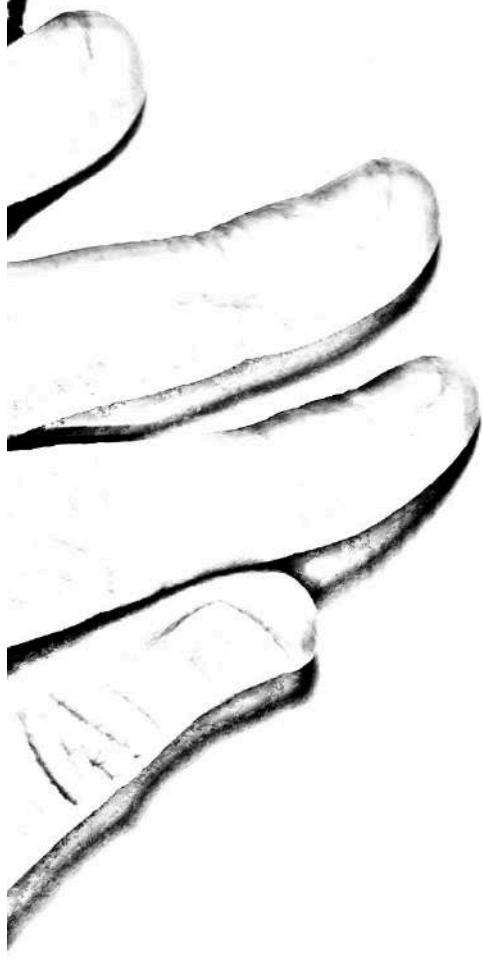
$0 < d \leq 4000$
 $-3600 \leq \theta \leq 3600$ (MP4100, 4200)
 $-2^{23} \leq \theta \leq 2^{23}-1$ (MP4300, 4400)

*When the "↑P" command is executed:

$-32767 \leq \theta \leq 32767$ (MP4100, 4200)
 $-2^{23} \leq \theta \leq 2^{23}-1$ (MP4300, 4400)
 $-8191 \leq x_n, y_n \leq 8191$ (MP4100, 4200)
 $-2^{23} \leq x_n, y_n \leq 2^{23}-1$ (MP4300, 4400)

Related commands

L, B, >, ↑P



Description

This command draws a string of points and hatches the area enclosed by it.

Specify the string of points as the absolute coordinates of the points which enclose the area to be hatched. Do not specify the start point again as the end point; a line connecting the start and end points will be drawn automatically.

Do not give the same data point twice in succession.

Parameter d specifies the line spacing of the hatching; it cannot be 0.

Note that when this parameter is too large, hatching cannot be drawn. (To fill in the specified area, specify parameter d as 5 or less.)

Parameter θ specifies the angle of hatching from the X-axis as an integral multiple of 0.1° , measured positively in the counterclockwise direction.

When the "↑P" command is executed, this parameter gives the angle from the angle reference specified by parameter θ_0 , expressed as an integral multiple of the angle unit specified by f .

Parameters d and θ are ignored when $n = 21$, but cannot be omitted because they are necessary as dummy parameters.

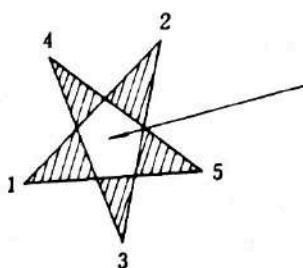
o Note the following restrictions on the number of data points:

- Hatching and clipping data is processed after being stored in the memory, so the number of data point is limited to: Number of clipping data points: maximum (200 points – number of clipping pattern points)

- Number of hatching data points: $200 - (\text{number of clipping data points} + \text{number of clipping pattern points})$

This means that up to 200 points can be specified if there is no clipping.

o When line segments cross each other, as in the figure below, an area without hatching is produced.



No hatching

The numbers give the sequence in which the points were specified.

Fig. 1-6-7

- o Keep the maximum number of intersections between one hatching line and a point string pattern at 30. If there are more than 30 intersections, hatching is not done from intersection 31 onward.

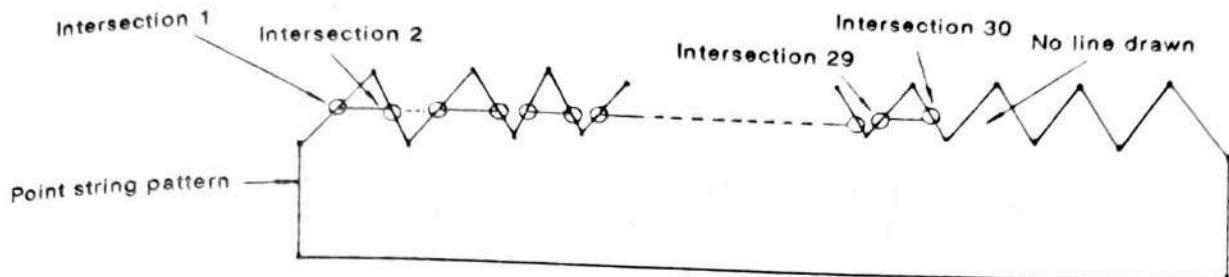


Fig. 1-6-8

Any line type specification by the "L" and "B" commands affects the frame lines only, not the hatching lines.

SP

SELECT POINT MARK command: Specification of marks

Command symbol

SP (Uppercase letter)

Function

Draws the specified character or mark at the end point of a straight line segment or a movement.

Input format

SPc (terminator)

Statement example

LPRINT "SPX"; CHR\$(3)

This draws an "X" at the end of each line segment or movement

Parameter range

c: 10_(H) ~ 7E_(H)90_(H) ~ FE_(H)

Related commands

M, D, E, O, MP, DP, EP, OP, Y, ←

Description

This command is useful for drawing graphs, etc., because it draws a specified character or mark at the end of each straight line segment or, in the case of a curve, at each specified coordinate point.

The characters and marks specified by this command are influenced by the character setting commands "S", "Q", "R", "I" and "A".

The marks provided by the MARK command "N" can also be specified by this command. This is explained below. (The same procedure can be used when specifying characters, etc., which are not available on the keyboard.)

Example

LPRINT "SP", CHR\$(18); CHR\$(3)

The codes for marks are:

CHR\$(17 ~ 32)



Refer to the code charts for details.

Fig. 1-6-9

* The character or mark drawn by this command is centered on the point to which the pen moves, although the center may be offset slightly, depending on the character or mark drawn.

1-7. Plotting area commands (6)

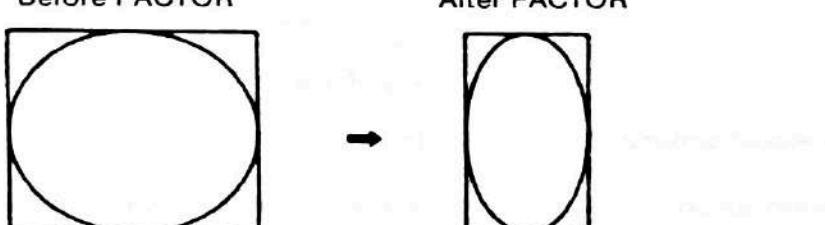
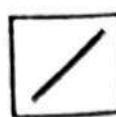
&	FACTOR command: Specification of plotting magnification
Command symbol	&
Function	Enlarges or reduces the plotting.
Input format	&p, q, r,
Statement example	LPRINT "&1, 2, 2,"
Parameter definitions	p/r: Magnification along X-axis q/r: Magnification along Y-axis
Parameter ranges	$0 < p, q, r \leq 8191$ (MP4100, 4200) $0 < p, q, r \leq 2^{23}-1$ (MP4300, 4400) $\frac{1}{4096} < \frac{p}{r}, \frac{q}{r} < 8$ (Coordinate values before multiplication by FACTOR)* (p/r or q/r) ≤ 8191 (MP4100, 4200) (Coordinate values before multiplication by FACTOR)* (p/r or q/r) $\leq 2^{23}-1$ (MP4300, 4400)
Related commands	The FACTOR command affects all plotting commands except UR, LL, OFFSET, and ROTATE.
Description	This command specifies the magnification (enlargement and reduction) of the plotting. All coordinates, lengths, character sizes, etc., are multiplied by p/r, q/r, but the values of the parameters of the OFFSET, UR, and LL commands are not affected. The initial setting of the parameters is p = q = r = 1.
Example	LPRINT "&1, 2, 2,"
	Before FACTOR After FACTOR 

Fig. 1-7-1



ROTATE command: Rotation of coordinate system

Command symbol

/ Rotates all coordinates.

Function

/ x, y, θ ,

Input format

LPRINT "/ 500, 500, 450,"

Statement example

This rotates the coordinate system through 45° (450) about (500, 500).

Parameter definitions

(x, y):

Center of rotation
Distances from coordinate origin,
integral multiples of GDU
Distances from OFFSET point when
OFFSET is executed.

θ :

Angle of rotation
Integral multiple of 0.1°, measured
positively in the counterclockwise
direction from the +X direction as
0°.

Parameter ranges

$-8191 \leq x, y \leq 8191$ (MP4100, 4200)

$-2^{23} \leq x, y \leq 2^{23}-1$ (MP4300, 4400)

Initial setting is (0,0)

$-32767 \leq \theta \leq 32767$ (MP4100, 4200)

$-2^{23} \leq \theta \leq 2^{23}-1$ (MP4300, 4400)

Initial setting is 0

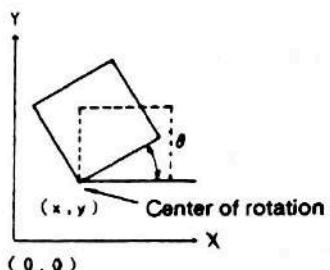


Fig. 1-7-2

Related commands

↑, ↑P

Description

This command rotates the coordinate system through the angle specified by θ , centered on the coordinates (x, y) from the coordinate origin (or the OFFSET point when OFFSET is executed).

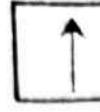
Express parameters x and y as integral multiples of the GDU.

Express θ as an integral multiple of 0.1° . All decimal points and decimal fractions are truncated.

Note that if (x, y) is specified outside the valid plotting area, plotting may not be done.

Once this command is issued, all subsequent plotting is affected, and the parameters of the command remain valid until they are reset or the plotter is initialized.

The center of rotation is not affected by the FACTOR command.

	OFFSET command: Movement of coordinate origin ↑ * " " in JIS code.
Command symbol	Moves the coordinate origin of the plotting.
Function	$\uparrow x, y,$
Input format	LPRINT " $\uparrow 500, 500,$ "
Statement example	This specifies point (500, 500) as the coordinate origin.
Parameter ranges	$-8191 \leq x, y \leq 8191$ (MP4100, 4200) $-2^{23} \leq x, y \leq 2^{23}-1$ (MP4300, 4400) x, y (integral multiples of GDU) and $-8191 \leq x + X_0 \leq 8191$ (MP4100, 4200) $-8191 \leq y + Y_0 \leq 8191$ $-2^{23} \leq x + X_0 \leq 2^{23}-1$ (MP4300, 4400) $-2^{23} \leq y + Y_0 \leq 2^{23}-1$
Related command:	$\uparrow P$
Description	<p>This command moves the coordinate origin (0,0) to the coordinate point specified by (x, y), relative to Home position in the absolute coordinate system. (OFFSET point setting)</p> <p>The plotting area moves at the same time.</p> <p>Specify parameters x and y as integral multiples of the GDU.</p> <p>This command affects all plotting commands received after it, and the values of its parameters remain effective until they are reset or the plotter is initialized.</p>

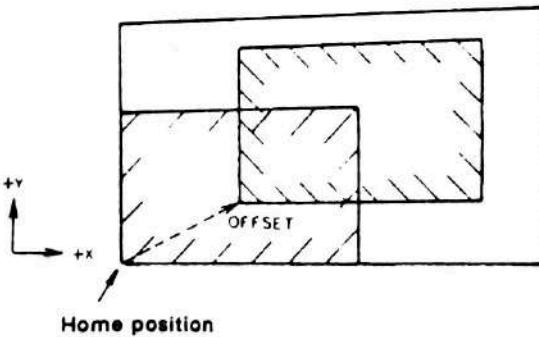


Fig. 1-7-3



WRITE LOWER LEFT commands: Specification of plotting area



WRITE UPPER RIGHT commands: Specification of plotting area.

Command symbols	WRITE LOWER LEFT \ * "¥" in JIS code WRITE UPPER RIGHT Z
Function	Specify the plotting area.
Input formats	WRITE LOWER LEFT \x, y, WRITE UPPER RIGHT Zx, y,
Statement example	LPRINT "\ 100, 100, Z2000, 2000," This specifies a range defined by the opposite corners (0, 0) and (2000, 2000) as the valid plotting area.
Parameter range	$-8191 \leq x, y \leq 8191$ (MP4100, 4200) $-2^{23} \leq x, y \leq 2^{23}-1$ (MP4300, 4400)
Description	<p>Use these commands to specify the coordinates of the corners (LOWER LEFT, UPPER RIGHT) of the plotting area from the controller.</p> <p>Express parameters x and y as coordinates which are integral multiples of GDU from the OFFSET point (see the description of the OFFSET command "↑").</p> <p>The initial setting of LOWER LEFT is (0, 0), and that of UPPER RIGHT gives the maximum valid plotting area.</p> <p>Once the valid plotting area is specified by these commands, plotting outside that area will not be done. This function can be used to omit part of a drawing deliberately.</p> <p>When the coordinate origin is moved by the OFFSET command, the plotting area moves at the same time.</p> <p>Therefore, when the coordinate origin itself is moved, the WRITE LOWER LEFT command makes it possible to specify negative coordinate values, so that negative coordinates can be used as well in the plotting.</p>

CLIPPING command: Clipping of plot

Command symbol

Function

Input formats

Statement example

Parameter definition

Parameter range

Related commands

Description

Sets an area in which plotting is inhibited, within the valid plotting area. (Clipping pattern setting)

$> x_1, y_1, x_2, y_2, \dots, x_n, y_n$ (terminator)
 $>$ (terminator)

LPRINT " $> 500, 500, 1000, 500, 1000, 1000,$
 $500, 1000, 500, 500"$, CHR\$(3)

This inhibits any subsequent plotting within a square area with sides of 50mm (500), the lower left corner being the point (500, 500).

x_n, y_n : String of points defining the clipping pattern. (Absolute coordinate system) (Integral multiple of GDU)

$-8191 \leq x, y \leq 8191$ (MP4100, 4200)

$-2^{23} \leq x, y \leq 2^{23}-1$ (MP4300, 4400)

Number of points given by $(x_n, y_n) \leq$ Number of bytes of polygon buffer/8

$\dagger, %$

This command clips part of the plotting (blanks it out).

When this command sets an area enclosed by the string of points (x_n, y_n) in the absolute coordinate system, all subsequent plotting within that area is prevented.

Example

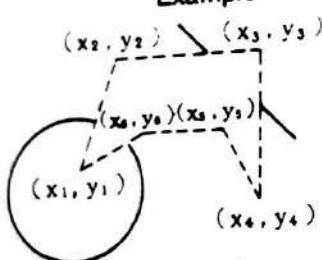


Fig. 1-7-4

- * Plotting cannot be guaranteed along the lines of the clipping pattern, so if you want to draw a line around the clipping pattern, use the clipping pattern data to draw the line first, then execute the CLIPPING command.

More than one clipping pattern can be specified, but note that the following restrictions are placed on the maximum number of points defining them.

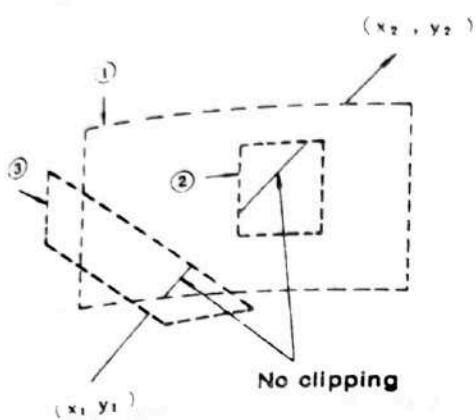


Fig. 1-7-5

Clipping and hatching data is processed after being stored in the memory, so the number of data points is limited to:

- (1) Number of clipping data points: Maximum (200 data points - number of clipping pattern points)
- (2) Number of hatching data points: 200 - (number of clipping data points + number of clipping pattern points)

If these limits are exceeded, data received subsequently is considered to be a parameter overflow error, and is ignored.

- If clipping patterns overlap, an area is generated in which there is no clipping.

If the three clipping patterns shown in Fig. 1-7-5 are specified, and a straight line is drawn from point (x_1, y_1) to point (x_2, y_2) , parts of the line will be drawn within the overlapped clipping areas.

- Keep the maximum number of intersections between a plotting line and a clipping pattern at 30. If there are more than 30 intersections, clipping will not be done from intersection 31 onward.

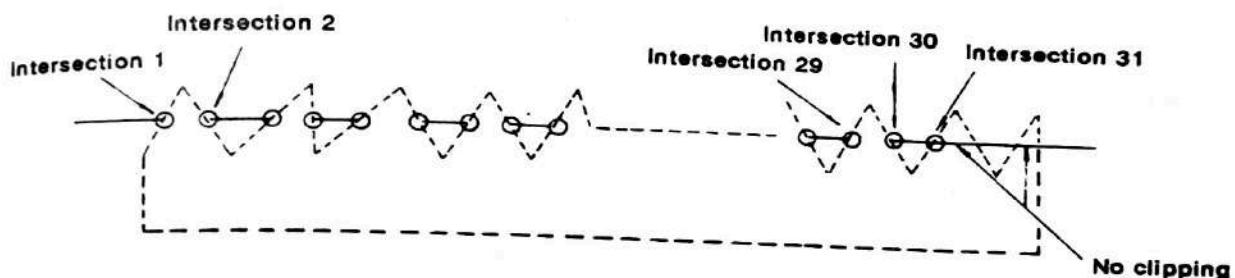


Fig. 1-7-6

To clear the clipping specification, either initialize the plotter or execute a CLIPPING command without any parameters.

This clears all the clipping data.

* It is not possible to clear only a selected clipping pattern.

Example

LPRINT ">"; CHR\$(3)

1-8. Plotting control commands (8)

-
-

CLEAR command: Clearing of settings

Command symbol :

Function : Initializes the plotter and returns all settings except for the pen conditions to their initial values. (Direct command)

Input format :

Statement example LPRINT ":";

Description : As soon as the plotter receives this command, it is initialized to the status it had when power was turned on, so that all settings except for the pen conditions (the pen speed, the pen acceleration and the pen pressure) are cleared and returned to their initial values.

* Leave at least 2 seconds between this and the next command.

* Be careful using this command during or at the end of a program; it will clear all data in the plotter's buffer.





INTERFACE CLEAR command: Clearing of interface settings

Command symbol

; (semi-colon)

Function

Clears I/O errors and data within the buffer memory, and returns the terminator to its initial setting.

Input format

;

Statement example

LPRINT ";" ;

Description

As soon as the plotter receives this command, I/O errors and data within the buffer memory are cleared, the terminator setting is returned to (ETX), and all interface conditions are initialized. (Direct command)

However, if the following command parameters are already set, they are all preserved:

LINE TYPE	"L"	WRITE LOWER LEFT	"\"
LINE SCALE	"B"	WRITE UPPER RIGHT	"Z"
FONT	"\$"	OFFSET	"↑"
ALPHA SCALE	"S"	FACTOR	"&"
ALPHA SPACE	"Q"	CLIPPING	">"
ALPHA ITALIC	"I"	ROTATE	" / "
ALPHA ROTATE	"R"	LABEL POSITION	"LP"

* Leave at least 2 seconds between this command and the next.

* Be careful about using this command during or at the end of a program; it will clear all data in the plotter's buffer.

H

HOME command: Return to HOME position

Command symbol

H (uppercase letter)

Function

Moves the pen to the HOME position (mechanical origin).

Input format

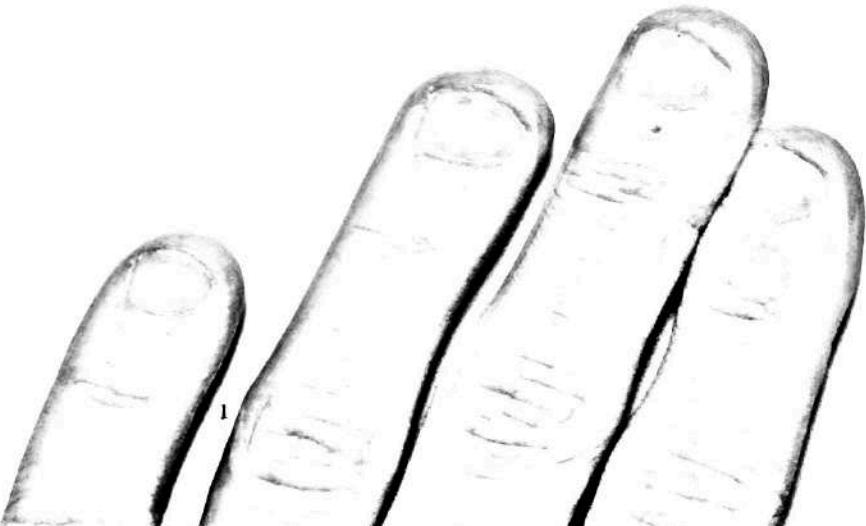
H

Statement example

LPRINT "H"

Description

This command returns the raised pen to the HOME position (mechanical origin). The HOME position is not affected by the setting of the plotting area.



J

NEW PEN command: Pen exchange

Command symbol

J (uppercase letter)

Function

Specifies an exchange of pens.

Input format

Jn,

Statement example

LPRINT "J2,"

Parameter range

0 ≤ n ≤ 8

Description

If this command is executed when a pen has been exchanged, the pen specified by parameter n is automatically selected.

Pen 1 is selected when the plotter is initialized.

If this command is not issued, the plotter will always use Pen 1 for drawing. When n = 0, the pen currently being used (the one in the pen carriage) is returned to the pen station.

When a plotting command is completed, or is suspended for 8 seconds or more, the pen carriage automatically returns its pen to the pen station (this is called the auto pen-stock operation) to prevent the ink drying up, and then waits for the next command at the position it was at before it returned the pen.

When the command is restarted, the carriage picks up the pen it had previously returned to the station, unless a pen exchange is instructed by the "J" command, and starts drawing from the position it was at before it returned the pen.

* When the plotter is initialized, the pen carriage stands by at the HOME position, then takes a pen from the station after it receives a plotting command.

* If an n = 0 "J" command is issued when the pen has been returned to the station by the auto pen-stock operation, the number of the pen is cleared from the memory (but the pen carriage does not move).

If a plotting command is executed in this state, the plotter (carriage) operates without holding a pen, unless a pen exchange command is received.

!

SPEED command: Pen speed

Command symbol

!

Function

Specifies the speed of the pen when it is down.

Input format

 $!l[, n]$ (terminator)

Statement example

LPRINT "!"5"; CHR\$(3)

Parameter ranges

 $0 \leq l \leq 10, 100 \leq l \leq 150$ (MP4100, 4200) $0 \leq l \leq 10, 100 \leq l \leq 164$ (MP4300, 4400) $1 \leq n \leq 8$

Description

This command specifies the plotting speed in 10 stages.

The pen speed is given by:

$$V = l * 500/10 \text{ (MP4100, 4200)}$$

$$V = l * 640/10 \text{ (MP4300, 4400)}$$

(When $l = 1$ to 10)

The pen speed when it is raised is always 500 mm/s (MP4100, 4200) or 640 mm/s (MP4300, 4400), regardless of the specification of this command.

Parameter n specifies the number of the pen whose speed is to be changed. When this is omitted, or when n is 0, the command applies to all the pens.

The relationship between parameter l and pen speed is given below.

Default value when parameter l = 0.

	DIP switch 1-Bit 7	
	OFF	ON
MP4100	500 mm/s	100 mm/s
MP4200		
MP4300	640 mm/s	100 mm/s
MP4400		

The relationship between parameter l and pen speed is given below.

MP4100, 4200

Parameter l	1	2	3	4	5
Pen speed	50 mm/s	100 mm/s	150 mm/s	200 mm/s	250 mm/s
Parameter l	6	7	8	9	10
Pen speed	300 mm/s	350 mm/s	400 mm/s	450 mm/s	500 mm/s

MP4300, 4400

Parameter ℓ	1	2	3	4	5
Pen speed	60 mm/s	120 mm/s	190 mm/s	250 mm/s	320 mm/s
Parameter ℓ	6	7	8	9	10
Pen speed	380 mm/s	440 mm/s	510 mm/s	570 mm/s	640 mm/s

By setting parameter ℓ within the range of 100 to 150 (MP4100, 4200) or 100 to 164 (MP4300, 4400), the pen speed can also be specified in 10 mm/s units. In this case, ($\ell-100$) becomes the pen speed. However, when $\ell = 100$, the pen speed becomes 500 mm/s (MP4100, 4200) or 640 mm/s (MP4300, 4400).

When a parameter is outside the specified range, the plotter ignores this command.

The MP4100 and MP4200 plotting speeds can be changed by pressing the FAST/SLOW key. When the FAST lamp is off (SLOW mode) the range of parameter ℓ is limited to the following:

$$1 \leq \ell \leq 2, 101 \leq \ell \leq 110$$

When a pen speed exceeding 100 mm/s is specified in the SLOW mode, the pen speed will be set to 100 mm/s. However, when the pen speed mode is changed to FAST mode, parameter ℓ becomes valid. The initial pen speed is determined by the setting of Bit 7 of DIP switch 1.

T

PROMPT LIGHT command: Controls the ON/OFF status of
the ALARM/PROMPT lamp

Command symbol

T (uppercase letter)

Function

Turns on and off the ALARM/PROMPT lamp on the control
panel.

Input format

Tn,

Statement example

LPRINT "T1,"

Parameter definition

n = 0: Turns off the ALARM/PROMPT lamp

n = 1: Turns on the ALARM/PROMPT lamp

Description

This command turns on and off the PROMPT lamp which also
acts as the ALARM lamp in the MP4000 series. This is used by
the computer to attract the operator's attention, or to tell him
that the plotter is ready to receive input.
1 and 0 are the only valid settings for the parameter n.

ERROR MASK command: Masking of error status

// Command symbol

Function

Input format

Statement example

Parameter definitions m:

Masks the error status.

"m,

LPRINT CHR\$(34); "17,"

Error mask m = 0 to 57

Initial setting m = 1

Each error can be masked so that its error indication disappears, by making the corresponding bit 0. If the bit of an error is 1, an error indication is given whenever that error occurs. This error masking affects the display on the control panel and the error statuses given by READ STATUS WORD 1 and READ STATUS WORD 3.

MSB	7	6	5	4	3	2	1	0	LSB
	0	0	E ₄	E ₅	E ₄	0	0	E ₁	

E1: Command error E4: Parameter error

E5: I/O error E6: Off scale

The values of all the bit settings are converted from binary into a decimal number and output.

Description

This command masks the error status of the plotter so that the generation of errors can be ignored, but an error display can be provided from the error contents.



TERM command: Terminator setting

Command symbol =

Function Specifies the data terminator(s).

Input format = t₁ t₂

Statement example LPRINT "=";CHR\$(13);CHR\$(10);

Parameter definitions

1) For data reception:

Either of the characters t₁ or t₂, or the sequence of two characters t₁ t₂, is handled as terminator.

2) For data transmission:

The sequence t₁ t₂ is added to the end of output data. When t₁ and t₂ are the same, only one character is added.

Note that t₁ and t₂ cannot be any of the characters command bytes, the numerals from 0 to 9, '-' (minus sign), or (60)₁₆ to (7F)₁₆.

Use codes from (00)₁₆ to (1F)₁₆.

Description

This command changes the terminator(s).

It may be difficult to read data output from the plotter if CR LF is not inserted at the end of the data. If this happens, it is necessary to use this command to change the terminator to CR LF.

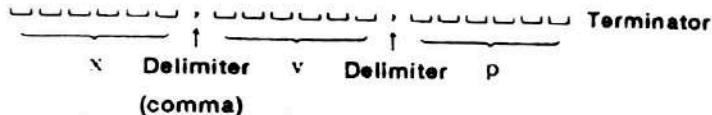
1-9. Digitization and read commands (8)

(These commands cannot be used in the Centronics Interface.)

G

GIN command: Digitization

Command symbol	G (Uppercase letter)		
Function	Outputs the coordinates of the pen (program coordinates) and its status (pen number, pen up or down) to the computer.		
Input format	G		
Statement example	PRINT #1, "G"		
Output format	Data output from plotter x,y,p (terminator)		
Parameter definitions	<p>x: X coordinate, 6 digits y: Y coordinate, 6 digits p: Pen status, 6 digits When p = 10: Pen 1 is up When p = 11: Pen 1 is down When p = 20: Pen 2 is up When p = 21: Pen 2 is down ⋮ ⋮ ⋮</p>		
Description	This command transmits the X and Y coordinates of the current pen position and the pen status to the computer.		
	The data output from the plotter in response to this command gives each of the X and Y coordinates and the status of the pen as a 6-digit decimal number, including a 1-digit sign ("-" or, for a positive number, a space). Any zeros to the left of significant digits are output as spaces.		



Usage example

100 PRINT #1, "="; CHR\$(13); CHR\$(10); Terminator change

PRINT #1, "G"
INPUT #1, X, Y, P
PRINT X, Y, P (X, Y): Current pen coordinates
P: Pen status

C
 Command symbol
 Function
 CALL GIN command: Digitization
 C (Uppercase letter)
 Puts the plotter in digitization mode, and outputs the coordinates of the pen (program coordinates) and its status (pen number, pen up or down) to the computer.

Input format
 Statement example
 PRINT #1, "C"
 Output format
 Data output from the plotter
 x,y,p (terminator)

Parameter definitions
 x:
 y:
 p:
 X coordinate, 6 digits
 Y coordinate, 6 digits
 Pen status, 6 digits
 When p = 10: Pen 1 is up
 When p = 11: Pen 1 is down
 When p = 20: Pen 2 is up
 When p = 21: Pen 2 is down

 ...

Description

This command puts the plotter in digitization mode, and transmits to the computer the coordinates and status of the pen when the pen has been moved by a keyboard operation to any desired point.

When this command is executed, PUSH ENTER KEY is displayed on the display.

If you now move the pen and press the ENTER key, the X and Y coordinates and status of the pen at that time will be output.

The data output from the plotter gives each of the X and Y coordinates and the status of the pen as a 6-digit decimal number, including a 1-digit sign ("-" or, for a positive number, a space). Any zeros to the left of significant digits are output as spaces.

000000 , 000000 , 000000
 _____ ↑ _____ ↑ _____
 x Delimiter y Delimiter p Terminator

Usage example

```

100 PRINT #1, "="; CHR$(13); CHR$(10); Terminator change
      |
      PRINT #1, "C"
      INPUT #1, X, Y, P
      PRINT X, Y, P
      |
      (X, Y): Current pen coordinates
      P:      Pen status
  
```



READ OFFSET command: Read-out of coordinate origin

Command symbol	?
Function	Outputs the coordinates of the origin (OFFSET point) to the computer.
Input format	?
Statement example	PRINT #1, "?"
Output format	Data output from the plotter x,y (terminator)
Parameter definitions	x: y: X coordinate of origin, 6 digits Y coordinate of origin, 6 digits The values (x, y) are the coordinates relative to the HOME position, output as integral multiples of the GDU.
Description	This command outputs the X and Y coordinate of the currently-set coordinate origin to the computer. When this command is executed, the data output from the plotter gives each of the X and Y coordinates as a 6-digit decimal number, including a 1-digit sign ("-" or, for a positive value, a space). Any zeros to the left of significant digits are output as spaces.
Usage example	100 PRINT #1, "="; CHR\$(13); CHR\$(10); PRINT #1, "?" INPUT #1, X, Y PRINT X, Y (X, Y): Coordinates of the coordinate origin (OFFSET point)

_____ , _____
 |
 x Delimiter y
 Terminator

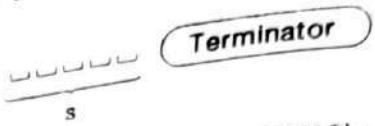
L	READ LOWER LEFT command	Read-out of valid plotting area
U	READ UPPER RIGHT command	Read-out of valid plotting area
Command symbols	[(READ LOWER LEFT) U (READ UPPER RIGHT)	
Function		Output to the computer the coordinates of the LOWER LEFT and UPPER RIGHT corners of the valid plotting area.
Input formats	[(READ LOWER LEFT) U (READ UPPER RIGHT)	
Statement examples		PRINT #1, "[" (READ LOWER LEFT) PRINT #1, "U" (READ UPPER RIGHT)
Output formats	Data output from plotter	x,y (terminator)
Parameter definitions	x: y:	x coordinate of LOWER LEFT or UPPER RIGHT corner, 6 digits y coordinate of LOWER LEFT or UPPER RIGHT corner, 6 digits The coordinates (x,y) are given relative to the OFFSET point. They are affected by FACTOR, so are ex- pressed in GDU.
Description	These commands output the x and y coordinates of the LOWER LEFT (L.L) or UPPER RIGHT (U.R.) corners of the valid plotting area which is currently set.	
	The data output from the plotter in response to these commands gives each of the x and y coordinates as a 6-digit decimal number, including a 1-digit sign ("-" or, for a positive value a space). Any zeros to the left of significant digits are output as spaces.	
	<p style="text-align: center;">x Delimiter y</p>	
Usage example	<pre> 100 PRINT #1, "="; CHR\$(13); CHR\$(10); PRINT #1, "[" INPUT #1, X, Y PRINT X, Y (X, Y): Coordinates of LOWER PRINT #1, "U" INPUT #1, X, Y PRINT X, Y (X, Y): Coordinates of UPPER </pre>	

V

READ STATUS WORD 1 command: Read-in of status

Command symbol	V (Uppercase letter)																										
Function	Outputs the plotter status to the computer.																										
Input format	V																										
Statement example	PRINT #1, "V";																										
Output format	Data output from plotter s (terminator)																										
Parameter definitions	s: Plotter status, 5 digits When this 5-digit decimal number is expressed in binary format, each bit has the following meaning.																										
	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: right;">MSB</td> <td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td> <td></td> <td>3</td><td>2</td><td>1</td><td>0</td> </tr> <tr> <td></td> <td>0</td><td>H</td><td>P</td><td>E</td><td>0</td><td></td><td>←</td> <td>B SPACE</td> <td></td><td></td><td></td><td></td> </tr> </table>	MSB	15	14	13	12	11	10	9		3	2	1	0		0	H	P	E	0		←	B SPACE				
MSB	15	14	13	12	11	10	9		3	2	1	0															
	0	H	P	E	0		←	B SPACE																			
	<p>H: This bit becomes 1 (ON) when the CHART HOLD key is on (MP4200, 4300, 4400).</p> <p>P: This bit becomes 1 (ON) when the PAUSE key is on (PAUSE lamp lights)</p> <p>B SPACE: Indicates the remaining amount of available memory in the buffer. When the available buffer space is less than 1664 bytes: B = available buffer space When the available buffer area is equal to or over 1664 bytes: B = 1664 (at the maximum buffer size)</p> <p>E: This bit becomes 1 (ON) if there is an error in the data received up to the execution of this command.</p>																										
Description	This command outputs to the computer the status of the plotter, and the buffer space available in the interface. When this command is executed, the plotter outputs its status data to the computer immediately after the plotter receives the command. (Direct command) This means that the computer can monitor the status of the plotter and the remaining interface buffer space at the time this command was output to the plotter. It is possible to control the buffer by using this command when the buffer control provided by hardware (using the ER signal) or X on/X off switching is disabled.																										

The data output from the plotter is a 5-digit decimal number.
Any zeros to the left of significant digits are output as
spaces.



Usage example

```
100 PRINT#1, "=";CHR$(13);CHR$(10);  
110 PRINT#1, "V"; No CR, LF output  
120 INPUT#1, S  
130 B=MOD(S,2048)  
140 E=MOD(S,8192)/4096  
150 PRINT B, E ← B: Buffer space E: Error status  
160 IF E < > 0 THEN Error handling  
170 IF B > 200 THEN 200  
180 A few seconds WAIT  
190 GO TO 110  
200 ⌂ Command output
```

(@)

READ STATUS WORD 2 command: Read-In of plotter status

Command symbol

@

Function

Outputs the plotter status to the computer

Input format

@

Statement example

PRINT #1, "@"

Output format

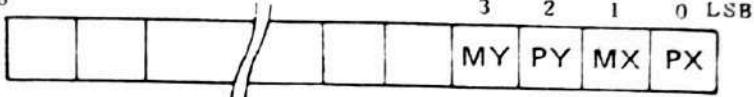
Data output from plotter
s (terminator)

Parameter definition

s: Plotter status, 5 digits

When this 5-digit decimal number is expressed in binary format, each bit has the following meaning:

MSB



PX:

1 when a command which off-scales in the +X direction of the plotting area is given.

MX:

1 when a command which off-scales in the -X direction of the plotting area is given.

PY:

1 when a command which off-scales in the +Y direction of the plotting area is given.

MY:

1 when a command which off-scales in the -Y direction of the plotting area is given.

Description

This command is stored temporarily in the buffer when it is received, and, when it is taken from the buffer, it outputs the status of the plotter to the computer.

It is possible to use this command to determine whether or not a given pen position (imaginary position which would move the pen out of the valid plotting area) is within the valid plotting area. The data output from the plotter is a 5-digit decimal number.

Any zeros to the left of significant digits are output as spaces.

S

Terminator

Usage example

```
100 PRINT #1, "="; CHR$(13); CHR$(10);
```

```
      f
```

```
PRINT #1, "@";
```

```
INPUT #1, S
```

```
PRINT S
```

```
      f
```

S: Plotter status

S = 0: Within plotting area

= 1: Off-scale in +X direction

= 2: Off-scale in -X direction

= 4: Off-scale in +Y direction

= 5: Off-scale in +X, +Y directions

= 6: Off-scale in -X, +Y directions

= 8: Off-scale in -Y direction

= 9: Off-scale in +X, -Y directions

= 10: Off-scale in -X, -Y directions

```
100 PRINT #1, "="; CHR$(13); CHR$(10);  
      f  
PRINT #1, "@";  
INPUT #1, S  
PRINT S  
      f  
S: Plotter status  
S = 0: Within plotting area  
= 1: Off-scale in +X direction  
= 2: Off-scale in -X direction  
= 4: Off-scale in +Y direction  
= 5: Off-scale in +X, +Y directions  
= 6: Off-scale in -X, +Y directions  
= 8: Off-scale in -Y direction  
= 9: Off-scale in +X, -Y directions  
= 10: Off-scale in -X, -Y directions
```



READ STATUS WORD 3 command: Read-in of error status

Command symbol	#
Function	Outputs information on the plotter's error status to the computer
Input format	#
Statement example	PRINT #1, "#"
Output format	Data output from the plotter s (terminator)
Parameter definition	s: When s Plotter error information, 1 digit =0: No error =1: Command error =4: Parameter overflow =5: I/O error =6: Overscale
Description	<p>These statuses are indicated in steps of 1, 4, 5, 6 ..., and are expressed in descending order of priority, with 1 having the highest priority. Therefore, when both command error and parameter overflow are generated, s = 1 is output.</p> <p>This command outputs error information on the plotter to computer.</p> <p>When this command is executed, the plotter outputs status data to the computer as soon as it receives the command. (Direct command)</p> <p>However, if the remaining buffer space in the plotter's interface is 255 bytes or less, the plotter waits until it becomes 256 or more before outputting the status data to the computer.</p> <p>This function prevents the buffer from filling up.</p> <p>The error information is valid only with respect to errors whose error marks are released by the ERROR MASK command.</p> <p>Error data is cleared when the READ STATUS WORD 3 command is executed. If this command is executed when there is more than one error, the error information is output in succession, starting with the smallest number. This means that all the error information can be posted, even when there are several errors.</p> <p>The data output from the plotter is a 1-digit decimal number.</p> <p>↳ terminator s</p>

Usage example

```
100 PRINT#1, "=";CHR$(13);CHR$(10);
110 PRINT#1, "#";
120 INPUT#1, S
130 PRINT S
140 IF S < > 0 THEN 110
      S: Error status
```

1-10. Polar coordinate commands (6)

DP	DRAW POLAR command: Straight-line drawing in polar coordinate system
-----------	----------------------------------------------------------------------

Command symbol	DP (uppercase letters)
Function	Draws a straight line starting from the current pen position, in the polar system set by the " $\uparrow P$ " command.
Input format	DP $r_1, \theta_1, r_2, \theta_2 \dots r_n, \theta_n$ (terminator)
Statement example	LPRINT "DP 300,450";CHR\$(3) This draws a straight line from the current pen position to the position 300 units away at 45°, from the polar origin.
Parameter definitions	<p>r: Distance from the polar origin (set by the "$\uparrow P$" command). (integral multiple of GDU)</p> <p>θ: Angle from the angle reference (0° direction) set by parameter θ_0 of the "$\uparrow P$" command, as seen from the polar origin (integral multiple of the angle unit defined by parameter f of the "$\uparrow P$" command).</p>

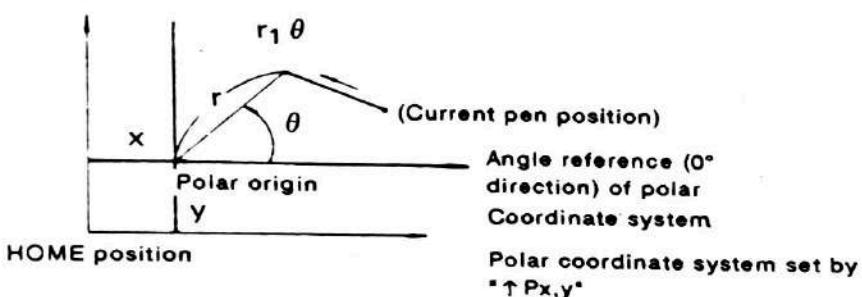


Fig. 1-10-1

Parameter ranges	$-8191 \leq r \leq 8191$ (MP4100, 4200) $-2^{23} \leq r \leq 2^{23}-1$ (MP4300, 4400) $-32767 \leq \theta \leq 32767$ (MP4100, 4200) $-2^{23} \leq \theta \leq 2^{23}-1$ (MP4300, 4400)
------------------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

Related commands	$\uparrow P, \uparrow I, L, B$
------------------	--------------------------------

Description

This command draws a straight line starting from the current pen position (r_0, θ_0) , and connecting in succession the specified polar coordinates $(r_1, \theta_1), (r_2, \theta_2), \dots, (r_n, \theta_n)$, in the polar coordinate system set by the " $\uparrow P$ " command.

Parameters r and θ are the distance and angle, respectively, from the polar origin set by the " $\uparrow P$ " command.

Any decimal point and decimal fraction are truncated.

Express θ as an integral multiple of the angle unit set by parameter f of the " $\uparrow P$ " command. It is measured positively in the counterclockwise direction from the angle reference set by parameter θ_0 of the " $\uparrow P$ " command.

When a parameter is outside the specified range, or when no parameters are given, or when parameters do not form a (r, θ) pair, it is handled as an error.

If a specified pair of coordinates is outside the valid plotting area, the pen draws the line up to the edge of the valid plotting area, stops there, and rises.

EP
RELATIVE DRAW POLAR command: Straight-line drawing between relative polar coordinates

Command symbol

EP (Uppercase letters)

Function

Draws a straight line from the current pen position to the coordinate point given by a displacement Δr and an angular difference $\Delta\theta$, in the polar coordinate system set by the " $\uparrow P$ " command.

Input format

EP $\Delta r_1, \Delta\theta_1, \Delta r_2, \Delta\theta_2, \dots, \Delta r_n, \Delta\theta_n$ (terminator)

Statement example

LPRINT "EP300, 200"; CHR\$(3)

This draws a straight line from the current pen position to a point 30 mm (300) away at 20° (200).

Parameter definitions

Δr : Displacement (integral multiple of GDU)
 $\Delta\theta$: The angle of the direction in which the pen moves from the angle reference (0° direction) in the polar coordinate system set by the " $\uparrow P$ " command. (Expressed as an integral multiple of the angle unit set by parameter f of the " $\uparrow P$ " command, measured positively in the counterclockwise direction).

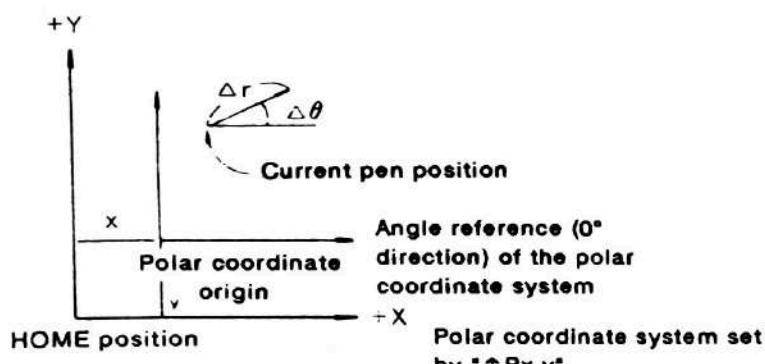


Fig. 1-10-2

Parameter ranges

 $-8191 \leq \Delta r \leq 8191$ (MP4100, 4200)
 $-2^{23} \leq \Delta r \leq 2^{23}-1$ (MP4300, 4400)
 $-32767 \leq \Delta\theta \leq 32767$ (MP4100, 4200)
 $-2^{23} \leq \Delta\theta \leq 2^{23}-1$ (MP4300, 4400)

Related commands

 $\uparrow P, \uparrow, /, L, B$

Description

This command draws a straight line from the current pen position (r_0, θ_0) to the coordinate point given by the displacement Δr and angular difference $\Delta\theta$, in the relative coordinate system specified by the " $\uparrow P$ " command. When more than one point is given, the line connects in succession the points which are specified as $(\Delta r, \Delta\theta)$ with respect to the previous point.

Express each parameter Δr as an integral multiple of GDU. Any decimal point and decimal fraction are truncated.

Express each θ as an integral multiple of the angle unit set by parameter f of the " $\uparrow P$ " command. It is measured positively in the counterclockwise direction from the angle reference (0° direction) specified by parameter θ_0 of the " $\uparrow P$ " command.

When a parameter is outside the specified range, or when no parameters are given, or when parameters do not form a pair, it is handled as an error.

If a specified pair of coordinates is outside the valid plotting area, the pen draws the line up to the edge of the valid plotting area, stops there, and rises.

MP

MOVE POLAR command: Movement of raised pen in polar coordinate system

Command symbol

Function

Input format

Statement example

Parameter definitions

Parameter ranges

Related commands

MP (Uppercase letters)

Moves the raised pen from its current position to the point specified by a distance r and angle θ in the polar coordinate system set by the " $\uparrow P$ " command.

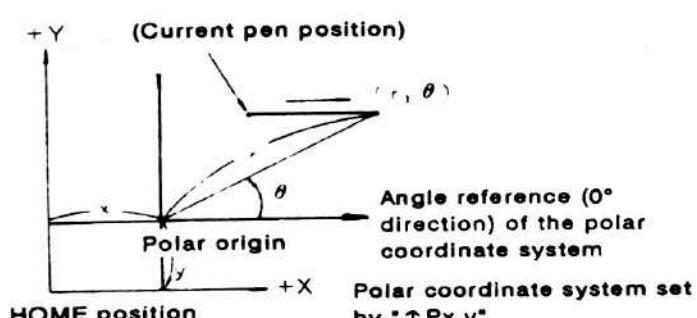
MP r, θ (terminator)

LPRINT "MP 500, 450 "; CHR \$ (3)

This moves the raised pen from the current position to the position 500 units away at 45° from the polar origin.

r: Distance from the polar origin (set by " $\uparrow P$ "). (Integral multiple of GDU)

θ : Angle from the angle reference (0° direction) set by parameter 0 of the " $\uparrow P$ " command.
(Integral multiple of the angle unit set by parameter f of the " $\uparrow P$ " command, measured positively in the counterclockwise direction.)

 $-8191 \leq r \leq 8191$ (MP4100, 4200) $-2^{23} \leq r \leq 2^{23}-1$ (MP4300, 4400) $-32767 \leq \theta \leq 32767$ (MP4100, 4200) $-2^{23} \leq \theta \leq 2^{23}-1$ (MP4300, 4400) **$\uparrow P, \uparrow, SP, /, L, B$** **Fig. 1-10-3**

Description

This command moves the raised pen from its current position to the point specified by the distance r and angle θ in the polar coordinate system set by the " $\uparrow P$ " command.

Parameter r and θ give the distance and angle from the origin of the polar coordinate system set by the " $\uparrow P$ " command.

Any decimal point and decimal fraction are truncated.

Express θ as an integral multiple of the angle unit set by parameter f of the " $\uparrow P$ " command. It is measured positively in the counterclockwise direction from the angle reference set by parameter θ_0 of the " $\uparrow P$ " command.

If a series of "MP" commands is input, the pen does not move to each point, it moves directly to the point determined to be the final point by the succession of MOVE POLARs.

If a specified pair of coordinates is outside the valid plotting area, the pen stops at the edge of the valid plotting area.

OP

RELATIVE MOVE POLAR command: Relative movement of raised pen in polar coordinate system

Command symbol

OP (uppercase letters)

Function

Moves the raised pen to the point given by a displacement Δr and angular difference $\Delta\theta$ from the current pen position, in the polar coordinate system set by the " $\uparrow P$ " command.

Input format

OP Δr , $\Delta\theta$ (terminator)

Statement example

LPRINT "OP300, 450"; CHR\$(3)

This moves the raised pen from its current position to a point 30 mm away at 45°

Parameter definitions

 Δr :

Displacement (integral multiple of GDU)

 $\Delta\theta$:

The angle of the pen movement from the angle reference (0° direction) of the polar coordinate system set by the " $\uparrow P$ " command. (Integral multiple of the angle unit set by parameter f of the " $\uparrow P$ " command, measured positively in the counterclockwise direction.)

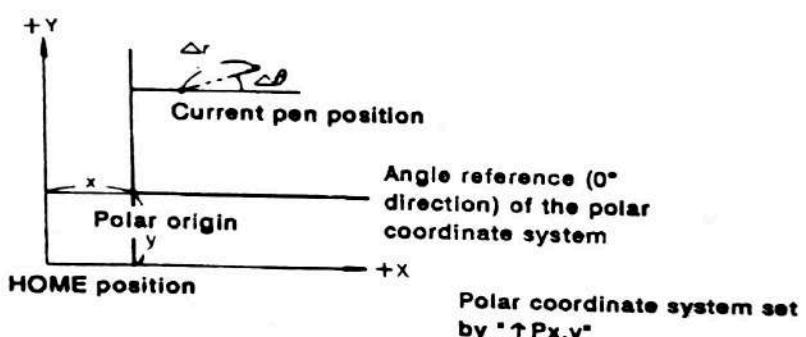


Fig. 1-10-4

Parameter ranges

 $-8191 \leq \Delta r \leq 8191$ (MP4100, 4200) $-2^{23} \leq \Delta r \leq 2^{23}-1$ (MP4300, 4400) $-32767 \leq \Delta\theta \leq 32767$ (MP4100, 4200) $-2^{23} \leq \Delta\theta \leq 2^{23}-1$ (MP4300, 4400)

Related commands

 $\uparrow P$, \uparrow , $/$, L, B

RP

Command

Function

Input fo

Statem

Param

Description

This command moves the raised pen to the coordinate point specified by the displacement Δr and angular difference $\Delta\theta$ from the current pen position (r_0, θ_0) , in the polar coordinate system set by the " $\uparrow P$ " command.

Express Δr as an integral multiple of the GDU. Any decimal point and decimal fraction are truncated.

Express θ as an integral multiple of the angle unit set by parameter f of the " $\uparrow P$ " command. It is measured positively in the counterclockwise direction from the angle reference (0° direction) set by parameter 0 of the " $\uparrow P$ " command.

If a series of "OP" commands is input, the pen does not move to each point, it moves directly to the point determined to be the final point by the series of "OP" commands.

When a parameter is outside the specified range, or when no parameters are specified, or when only one parameter is given, the plotter handles this as an error.

If a specified pair of coordinates is outside the valid plotting area, the pen moves to the edge of the plotting area and stops.

RP**RADIUS PLOT command: Radial plotting**

Command symbol

Function

Input format

Statement example

Parameter definitions

RP (Uppercase letters)

Draws a straight line segment of a specified length, in the direction of the angle from the origin of the polar coordinate system set by the "↑P" command. By making the center of a circle the polar origin, you can easily draw partition lines or pointers.

RP θ , ℓ_1 , ℓ_2 (terminator)

LPRINT "RP300, 250, 1000"; CHR\$(3)

This draws a line segment of 25 mm (250) in the 30° (300) direction, starting from a point 100 mm (1000) away from the polar origin.

 θ :

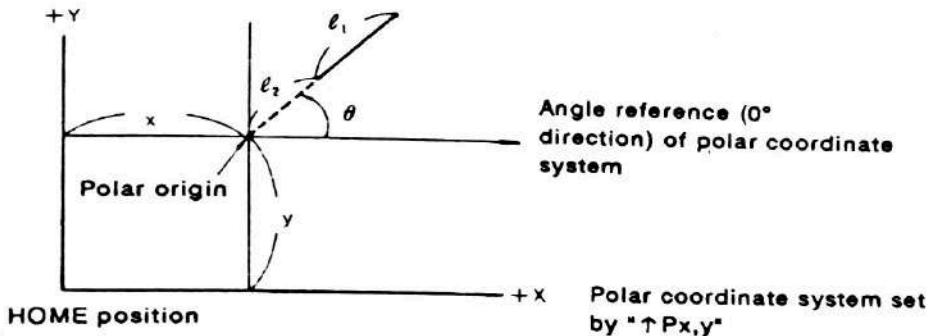
Angle from the angle reference (0° direction) set by parameter θ of the "↑P" command. (Expressed as an integral multiple of the angle unit set by parameter f of the "↑P" command, measured positively in the counterclockwise direction.)

 ℓ_2 :

Distance from the polar origin to the start of the line (integral multiple of GDU).

 ℓ_1 :

Length of the line segment from ℓ_2 .

**Fig. 1-10-5**

Parameter ranges

 $-32767 \leq \theta \leq 32767$ (MP4100, 4200) $-2^{23} \leq \theta \leq 2^{23}-1$ (MP4300, 4400) $-8191 \leq \ell_1, \ell_2 \leq 8191$ (MP4100, 4200) $|\ell_1 - \ell_2| \leq 8191$ $-2^{23} \leq \ell_1, \ell_2 \leq 2^{23}-1$ (MP4300, 4400) $|\ell_1 - \ell_2| \leq 2^{23}-1$

Related commands

↑P, ↑/, /

Description

This command draws a straight line segment of the specified length ℓ_1 in the direction, starting from a point at a distance of ℓ_2 from the origin of the polar coordinate system set by the " $\uparrow P$ " command.

Parameter θ represents the angle when the polar origin is taken as the center. Express it as an integral multiple of the angle unit set by parameter f of the " $\uparrow P$ " command, measured positively in counterclockwise direction from the angle reference (0°) set by parameter θ of the " $\uparrow P$ " command.

Parameter ℓ_2 specifies the start point of the straight line segment, and parameter ℓ_1 specifies the length of the line.

When the value of parameter ℓ_1 is a positive number, the line is drawn away from the origin, starting from the point specified by ℓ_2 . This enables you to draw pointers for circular graphs, for example.

When parameter ℓ_1 is negative, the line is drawn towards the origin, so you can use this to draw partition lines in a circle, for example.

Any decimal points and decimal fractions will be truncated.



OFFSET POLAR command: Setting of origin of polar coordinate system

Command symbol

$\uparrow P$ (" \uparrow " is " \wedge " in the JIS code.)

Function

Sets the origin of the polar coordinate system.

Input format

$\uparrow P \, x, y [, \theta_0 [, f]]$ (terminator)

Statement example

LPRINT " $\uparrow P \, 1000, 1000, 900, -100$ "; CHR \$3
This rotates through 90° the coordinate system whose polar origin is set at (1000, 1000).
The angle unit of the polar coordinate system is set as 3.6°, and angles are measured positively in the counterclockwise direction.

Parameter definitions

x, y:

Distances from the coordinate origin (or the OFFSET point when OFFSET is executed)

(Integral multiples of GDU)

θ :

Angle of inclination from the angle reference (0° direction), measured with respect to the +X-axis direction (or the specified rotation angle when ROTATE is executed).

(Integral multiple of 0.1°, measured positively in the counterclockwise direction)

f:

Number of divisions of angle

(The entire circumference of 360° is expressed as an integer set by f. Angles are measured positively in the counterclockwise direction, but can be measured positively in the clockwise direction if this value is made negative.) All subsequent commands relating to the polar coordinate system are affected by this setting.

This also sets the angle unit for parameter of the polar coordinate commands "DP", "MP", "RP", "EP", and "OP".

Can be omitted

Parameter ranges

$-8191 \leq x, y \leq 8191$ (MP4100, 4200)

$-2^{23} \leq x, y \leq 2^{23}-1$ (MP4300, 4400)

$-32767 \leq \theta_0 \leq 32767$ (MP4100, 4200)

$-2^{23} \leq \theta_0 \leq 2^{23}-1$ (MP4300, 4400)

Default value is 0

$-32767 \leq f \leq 32767$ (MP4100, 4200)

$-2^{23} \leq f \leq 2^{23}-1$ (MP4300, 4400)

Related commands

DP, MP, OP, EP, %, RP

Description

This command sets the origin of the polar coordinate system used by the other polar coordinate commands "MP", "DP", "OP", "EP", and "RP".

(If the origin is not set, the OFFSET point becomes the origin.)

θ_0 is the angular difference between the 0° direction of the polar coordinate system and the 0° direction (+X direction) of the absolute coordinate system (or the specified rotation angle when ROTATE is executed), measured positively in the counterclockwise direction and expressed as an integral multiple of 0.1° .

You can omit this parameter; if it is omitted, the plotter assumes a value of 0.

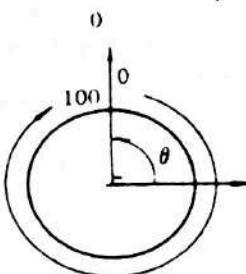
Parameter f gives the number of divisions of the entire circumference (360°), and sets the minimum unit for parameter of the "MP", "EP", "DP", "OP", and "RP" commands.

Specify an integer valid within the parameter range (but not 0), measured positively in the counterclockwise direction. (0.1° is the programmable limit, so the final resolution is 0.1° for all values from 3600 upward.)

If you set a negative value for this parameter, all angles in the polar coordinate commands are measured positively in the clockwise direction. Only parameter θ_0 of the " $\uparrow P$ " command is not affected. Parameter f can also be omitted; if it is omitted, a value of 3600 is assumed.

When giving plotting data in which the clockwise direction is positive, make the number of divisions a negative number.

Examples When $\theta = 900$ and $f = -100$:



The circumference is divided into 100 parts, with the 90° direction taken as 0° . (Angles are measured positively in the clockwise direction.)

(For a circular graph, $\theta = 1$ now represents 1%.)

$$0 \leq \theta \leq 100$$

Fig. 1-10-6

When $\theta_0 = 900$, $f = -6$

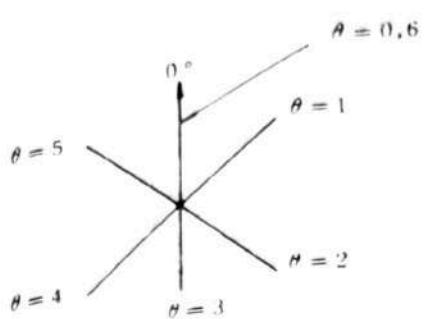


Fig. 1-10-7

The circumference is divided into 6 parts, with the 90° direction taken as 0° . (Angles are measured positively in the clockwise direction)
(For a radar chart, θ can now be specified as each item number)

1-11. Notes on the command functions

1-11-1. Initial settings
 The initial setting of each command is shown in Table 1-11-1.

Table 1-11-1 Initial settings

Command	Parameter	Remarks
LINE TYPE	$P = 0$	Solid line
LINE SCALE	$\ell = 100$	
WRITE LOWER LEFT	$x = 0$ $y = 0$	Home position
WRITE UPPER RIGHT	$x = 4040$ $y = 2850$	Varies according to DIP switch setting
OFFSET	$x = 0$ $y = 0$	Home position
OFFSET POLAR	$x = 0$ $y = 0$ $\theta_0 = 0$ $f = 3600$	Home position No rotation
FACTOR	$p = 1$ $q = 1$ $r = 1$	Magnification = 1
ALPHA SCALE	$n = m = 30$	
ALPHA SPACE	$\ell = 30$ $k = 0$	
ALPHA ROTATE	$\theta = 0$	No rotation
ALPHA ITALIC	$p = 0$	No tilting
FONT	$n = 60$	STANDARD codes Varies according to DIP switch setting
LABEL POSITION	$m = 8$ $n = 1$	
SELECT POINT MARK	$c = 0$	No print

Command	Parameter	Remarks
SPEED	$\ell = 0$	Speed depends on pen type.
NEW PEN	$n = 1$	
TERM	$t_1 = t_2 = (\text{ETX})$	
ERROR MASK	$m = 1$	Command error
ROTATE	$x = 0$ $y = 0$ $\theta = 0$	No rotation specification

1-11-2. The influence of commands
The plotting commands which are affected by other commands are listed below.

Table 1-11-2 Influence of commands

Commands with influence	Commands affected
ALPHA SCALE ALPHA SPACE ALPHA ITALIC ALPHA ROTATE ALPHA RESET	PRINT KANA (GREEK) MARK USER'S PROGRAM PATTERN SELECT POINT MARK
LINE TYPE LINE SCALE	DRAW RELATIVE DRAW CURVE RELATIVE CURVE CIRCLE RELATIVE CIRCLE ELLIPSE DRAW POLAR RELATIVE DRAW POLAR RADIUS PLOT
SELECT POINT MARK	DRAW RELATIVE DRAW MOVE RELATIVE MOVE CURVE RELATIVE CURVE DRAW POLAR RELATIVE DRAW POLAR MOVE POLAR RELATIVE MOVE POLAR RADIUS PLOT

Table 1-11-2 Influence of commands

Commands with influence	Commands affected
OFFSET POLAR	DRAW POLAR RELATIVE DRAW POLAR MOVE POLAR RELATIVE MOVE POLAR RADIUS PLOT
LABEL POSITION	PRINT KANA(GREEK)
FACTOR ROTATE	All commands except for OFFSET, UR, LL
CLIPPING	All plotting commands
LINE TYPE LINE SCALE	HATCHING (Frame lines only)
OFFSET POLAR	HATCHING Angle of hatching lines and angles setting the drawing range of circular hatching.

1-11-3. Direct commands

READ STATUS WORD 1, READ STATUS WORD 3, CLEAR, and INTERFACE CLEAR are direct commands which are executed immediately they are received. The other commands are performed in the order they have been stored in the buffer.

1-11-4. Plotting area and off-scale controls

The plotting area is the area set by WRITE LOWER LEFT and WRITE UPPER RIGHT. When a program tries to plot outside that area, drawing outside the area is prevented. Drawing outside the physically valid plotting area is prevented as well, even if a plotting area which exceeds it has been defined. These are the off-scale controls.

If a plotting command such as that shown in Fig. 1-11-4 is given to draw a line along $P_1 \rightarrow P_2 \rightarrow P_3 \rightarrow P_4$, the actual movements of the pen are:

$P_1 \rightarrow A$ (pen down)
 $A \rightarrow B$ (pen up)
 $B \rightarrow P_4$ (pen down)

A line is drawn only between $P_1 \rightarrow A$ and $B \rightarrow P_4$. No distortion of plotting positions is caused by off-scale.

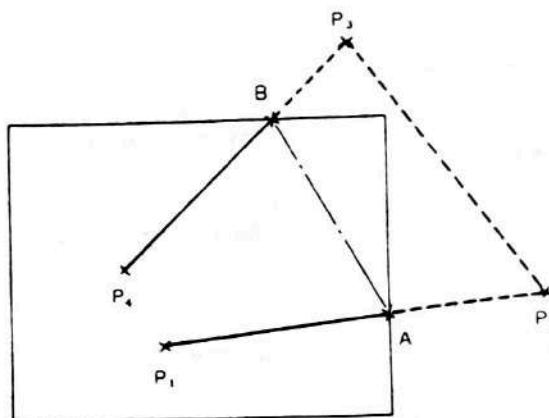


Fig. 1-11-4 Off-scale control

1-11-5. Handling of errors

There are 3 main causes of errors:

a) Data error:

Errors in the format, etc., of the input data. These occur if, for example, the x coordinate is given but not the y coordinate, or a terminator is omitted although one is necessary, etc.

When such an error occurs, the corresponding ERROR bit becomes 1 (ALARM lamp lights), and commands are temporarily inhibited, except for direct commands. (This can be masked by an ERROR MASK command.)

These errors are further divided into the following 2 types:

- Command error

When a code between (60)₁₆ and (7E)₁₆ has been handled as a command character.

- Parameter overflow

When a numerical value exceeding the ranges -8191 ~ 8191 (MP4100, 4200), - 2^{23} ~ 2^{23} - 1 (MP4300, 4400) was handled as a parameter.

b) I/O error

Error relating to data reception in the interface unit. Errors in data transmission (e.g. when there is no listener when about to output data specified by talker, etc.) with the GP-IB interface, or parity, framing, overrun errors in the RS-232-C interface fall within this category.

c) Off-scale

When data instructing plotting outside the valid area is handled, the off-scale error status bit becomes 1.

When data instructing a return to the valid plotting area is handled, the off-scale bit becomes 0.

d) Error clearance

Errors are cleared by the following means. The status of the ERROR bits is 0 when the corresponding errors are cleared.

- I) Execute a READ STATUS WORD 1 or READ STATUS WORD 3 command.
- II) Press ENTER (only data format error cleared).
- III) Initialize the plotter.
- IV) Execute an INTERFACE CLEAR command.

Note:

If I) and II) are done when the execution of the next command has been temporarily inhibited by a data format error, that command will be executed. III) and IV) clear the data within the buffer memory.

2. COMMAND LIST
2-1. Formats and functions of Graphtec commands

	Command	Data format	Function	Remarks
Straight line movements	DRAW	$Dx_1, Y_1, x_2, y_2, \dots, x_n, y_n(t)$	Draws straight line segments connecting the points $(x_1, y_1), (x_2, y_2) \dots, (x_n, y_n)$.	LINE TYPE and LINE SCALE settings are valid. For specification of (t) see the TERM command.
RELATIVE DRAW		$E_{\Delta x_1, \Delta y_1, \Delta x_2, \Delta y_2, \dots, \Delta x_n, \Delta y_n(t)}$	Draws straight line segments with the relative displacements $(\Delta x_1, \Delta y_1), (\Delta x_2, \Delta y_2) \dots, (\Delta x_n, \Delta y_n)$.	
MOVE		$M x, y,$	Moves the raised pen to coordinates (x, y) .	
RELATIVE MOVE		$Q_{\Delta x, \Delta y},$	Moves the raised pen from its current position to the relative point $(\Delta x, \Delta y)$.	
DRAW POLAR		$DP_{r_1, \theta_1, r_2, \theta_2, \dots, r_n, \theta_n(t)}$	Draws straight line segments connecting the points $(r_1, \theta_1), (r_2, \theta_2) \dots, (r_n, \theta_n)$ in the polar coordinate system.	LINE TYPE and LINE SCALE settings are valid.
RELATIVE DRAW POLAR		$EP_{\Delta r_1, \Delta \theta_1, \Delta r_2, \Delta \theta_2, \dots, \Delta r_n, \Delta \theta_n(t)}$	Draws straight line segments with the relative displacements $(\Delta r_1, \Delta \theta_1), (\Delta r_2, \Delta \theta_2) \dots, (\Delta r_n, \Delta \theta_n)$ in the polar coordinate system.	
MOVE POLAR		$MP_{r, \theta(t)}$	Moves the raised pen to coordinates (r_1, θ) in the polar coordinate system.	

	RELATIVE MOVE POLAR	OP $\Delta r, \Delta\theta(T)$	Moves the raised pen from its current pen position to the relative point ($\Delta r, \Delta\theta$) in the polar coordinate system.	
	RADIUS PLOT	RP, θ_1, θ_2	Draws a straight line with a length of θ_1 , from $(0, \theta_2)$ in the polar coordinate system.	LINE TYPE and LINE SCALE settings are valid.
Characters and symbols	PRINT	P c ₁ c ₂ c _n (l)	Writes the alphanumerics specified by the codes c ₁ , c ₂ c _n . (See the code charts at the end of this manual)	ALPHA RESET, ALPHA SCALE, ALPHA SPACE, ALPHA ROTATE, and ALPHA ITALIC settings are valid.
	KANA (GREEK)	K c ₁ c ₂ c _n (l)	Writes the katakana characters and Greek characters specified by codes c ₁ , c ₂ c _n . (See the code charts at the end of this manual)	
	MARK	N n,	Draws the symbol specified by n centered on the current pen position.	
	SELECT POINT MARK	SPc (l)	Draws one character or symbol specified by c centered on the end point of a straight line or a pen movement.	
	USER'S PROGRAM PATTERN	(P(p), $\Delta x_1, \Delta y_1, (p), \Delta x_2, \Delta y_2$ (p), $\Delta x_n, \Delta y_n$	Draws patterns specified by pen status p and pen displacements $\Delta x, \Delta y$.	

	CIRCLE	W x ₀ , y ₀ , r ₁ , r ₂ , θ_1 , θ_2 , [d](t)	Draws a circle, arc or spiral. (x ₀ , y ₀): coordinates of center (r ₀ , r ₂): initial and final radii (θ_1 , θ_2): initial and final angles d: angle or number of segments	
	RELATIVE CIRCLE]r ₁ , r ₂ , θ_1 , θ_2 , [d], (t)	Draws a circle, arc or spiral. (r ₁ , r ₂): initial and final radii (θ_1 , θ_2): initial and final angles d: angle or number of segments The start point is the current pen position.	
	CURVE	Y a, x ₁ , y ₁ , x ₂ , y ₂ x _n , y _n (l)	Draws a smooth curve through the points with coordinates (x ₁ , y ₁), (x ₂ , y ₂) (x _n , y _n). a = 0: open curve a = 1: closed curve	For specification of (t) see the TERM command.
	RELATIVE CURVE	\leftarrow a, $\Delta x_1, \Delta y_1, \Delta x_2, \Delta y_2$ $\Delta x_n, \Delta y_n$ (t)	Draws a smooth curve through points given by successive relative displacements. ($\Delta x_1, \Delta y_1$): relative coordinates of the start point of the curve from the current pen position ($\Delta x_2, \Delta y_2$): ... ($\Delta x_n, \Delta y_n$) relative direct displacements of successive points a = 0: open curve a = 1: closed curve	The " \leftarrow " character is " \sim " in the JIS codes.

	ELLIPSE	$(a, x_0, y_0, r_1, r_2, \theta_1, \theta_2, \theta_3)$	<p>Draws an ellipse</p> <p>a: the pen moves from its current position to the start point, raised when $a = 0$ and lowered when $a = 1$.</p> <p>(x_0, y_0): center of ellipse</p> <p>(r_1, r_2): major and minor radii</p> <p>(θ_1, θ_2): initial and final angle of ellipse</p> <p>θ_3: Angles between major axis and X-axis</p>	
Line type specification	LINE TYPE	L p.	<p>Specifies the line type.</p> <p>p = 0: solid line</p> <p>p = 1 - 4: dotted and broken lines</p> <p>p = 5 - 6: dot-dash lines</p> <p>p = 7 - 8: double-dot-dash lines</p>	Initial setting is $p = 0$
	LINE SCALE	B ℓ	Specifies the pitch for broken lines by ℓ (Has no effect on solid lines)	Initial setting is $\ell = 100$
Character and symbol specifications	FONT	\$n, (m.)	Selects type of characters written by PRINT and KANA commands according to the character code charts by parameter n, and the resolution of characters by parameter m.	Initial setting is $n = 60$, $m = 8$
	ALPHA SCALE	S n, (m.)	n specifies the height of characters and symbols and m their width.	Initial setting is $n = m = 30$
	ALPHA SPACE	Q ℓ , [k.]	n specifies the horizontal spacing from one character or symbol to the next, and k the vertical spacing.	Initial setting is $\ell = 30$, $k = 0$

	ALPHA ROTATE	R θ ,	θ specifies the rotation of characters and symbols.	Initial setting is $\theta = 0$
	ALPHA ITALIC	I p.	p specifies the slope of characters and symbols. $p = 256 \tan\theta$ (θ is the inclination from the Y-axis)	Initial setting is $p = 0$
	LABEL POSITION	L P n (l)	Moves the start point of character string writing to the place specified by n.	Initial setting is $n = 1$.
	ALPHA RESET	A	Returns character and symbol specifications to their initial values.	
Control functions	CLEAR	:	Initializes the plotter, returns all control settings to their initial values.	
	HOME	H	Moves the raised pen to the HOME position.	
	OFFSET	$\uparrow x, y,$	Sets the origin to the coordinates (x, y).	Initial setting is the same as the HOME POSITION. "↑" is "⌞" in JIS codes.

	OFFSET POLAR tPx,y[,θ0[,l]] (l)	Sets the polar origin at (x, y). Rotates coordinate system by θ, centered on (x, y). l sets a division angle for the whole circle.	Initial setting is the HOME POSITION, θ0 = 0, l = 3600
	NEW PEN J n,	Selects pen n	Initial setting is n = 1
	PROMPT LIGHT T n,	Controls the ALARM/PROMPT lamp n = 0: off n = 1: on	Initial setting is off.
	WRITE LOWER LEFT \\x,y,	Specifies the coordinates of the lower left corner of the plotting area.	Initial setting is x = y = 0
	WRITE UPPER RIGHT Z x,y,	Specifies the coordinates of the upper right corner of the plotting area.	Initial setting gives the maximum plotting area.
	ROTATE /x,y..	Rotates drawing around (x,y). (x,y): center of rotation θ: angle of rotation	
	CLIPPING > x1,y1, ..., xn,yn (t)	Clips part of drawing. xn, yn: string of points defining clipping pattern	

	SPEED l ε [,n](t)	Sets the pen speed when down, in 10 stages. (ε = 1, 2, ..., 10) n: specified pen number	Initial setting is ε = 0
	FACTOR &, p,q,r,	Sets the plotting magnification. p/r = magnification along X-axis q/r = magnification along Y-axis	Initial setting is p = q = r = 1
Read-out of coordinates	GIN G	Transmits the current pen x and y coordinates and pen up/down status to the computer.	Data is transmitted in the order: x coordinate, y coordinate, pen status.
	CALL GIN C	Transmits the current pen position and pen status when the ENTER key on the control panel is pressed.	
	READ OFFSET ?	Transmits the coordinates of the origin to the computer.	
	READ LOWER LEFT l	Transmits the coordinates of the lower left corner of the plotting area to the computer.	
	READ UPPER RIGHT U	Transmits the coordinates of the upper right corner of the plotting area to the computer.	Data is transmitted in the order: x coordinate then y coordinate.

Interface control	INTERFACE CLEAR	:	Initializes interface control. Any data remaining in the buffer will be lost.	
	READ STATUS WORD 1	V	Transmits plotter status 1 to the computer. Transmission takes place immediately this command is received.	
	READ STATUS WORD 2	@	Transmits plotter status 2 to the computer.	
	READ STATUS WORD 3	#	Transmits plotter status 3 to the computer. Transmission takes place if the buffer space available is at least 256 bytes when this command is received.	
	TERM	=t ₁ ,t ₂	Specifies the data terminator characters t ₁ and t ₂ . t ₁ and t ₂ may be the same.	Initial setting is t ₁ = t ₂ = (ETX)
	ERROR MASK	"m,		Initial setting is m = 1

Graph plotting	AXIS	Xp,q,r,[t ₁ ,t ₂]	Draws a coordinate axis parallel to the X- or Y-axis. p = 0 (Y-axis) q = unit length. p = 1 (X-axis) r - number of repeats p = 2 (Y-axis) q - total length. p = 3 (X-axis) r = number of divisions	t ₁ ,t ₂ - lengths of scale marks
	HATCHING	%n,x,y,d,(l)	Draws a rectangle parallel to the X- and Y-axes, a circle, or straight line segments connecting a string of points, and also hatching. n = 1: rectangle only n = 2: hatching only n = 3: rectangle with internal hatching d: line spacing of hatching l: angle of hatching from X-axis	
		%n,r ₁ ,r ₂ ,θ ₁ ,θ ₂ ,d,(l)	n = 11: fan shape only n = 12: hatching only n = 13: fan with hatching r ₁ ,r ₂ : radii of circle θ ₁ ,θ ₂ : start and end of fan drawn d,: same as for rectangle	
		%n,d,θ,x ₁ ,y ₁ ,..... x _n ,y _n (l)	n = 21: string of points n = 22: hatching only n = 23: string of points with internal hatching d,: same as for rectangle x _n ,y _n : coordinates of points	

3. CHARACTER CODE CHARTS (when using GP-GL commands)

3-1 Alphanumeric and kana code charts

Code chart 1 FONT \$ 0, (Standard)

B ₈ = 0 (When using 8-bit code)								B ₈ = 1 (When using 8-bit code)							
S 1								S 0							
B ₇	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1
B ₆	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1
B ₅	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0
B ₄ B ₃ B ₂ B ₁	0	1	2	3	4	5	6	7	0(B)	1(9)	2(A)	3(B)	4(C)	5(D)	6(E)
0 0 0 0	0	SP	SP	0	@	P	·	p	SP	SP	-	♪	!	SP	-
0 0 0 1	1	·	!	1	A	Q	a	q	Γ	○	7	+	△	α	ρ
0 0 1 0	2	◊	#	2	B	R	b	r	Δ	「	イ	ソ	メ	β	σ
0 0 1 1	3	ETX	□	#	3	C	S	c	s	ETX	Z	」	ウ	テ	γ
0 1 0 0	4	△	\$	4	D	T	d	t	(H)	·	エ	ト	タ	δ	υ
0 1 0 1	5	○	%	5	E	U	e	u	Λ	·	オ	ナ	ユ	ε	φ
0 1 1 0	6	⊗	&	6	F	V	f	v	(H)	『	カ	ニ	ヨ	ζ	χ
0 1 1 1	7	×	,	7	G	W	g	w	O	·	キ	ヌ	ラ	η	φ
1 0 0 0	8	BS	+	(H	X	h	x	BS	Π	·	ク	ネ	リ	δ
1 0 0 1	9	Y)	9	I	Y	i	y	Σ	·	ケ	ノ	ル	ε	γ
1 0 1 0	A	LF	◆	*	J	Z	j	z	LF	Υ	·	コ	ハ	レ	ζ
1 0 1 1	B	⊗	+	:	K	(k)	Φ	·	タ	ヒ	ロ	λ	ε
1 1 0 0	C	⊗	,	<	L	\	l		Ψ	·	シ	フ	フ	ν	ε
1 1 0 1	D	CR	⊗	-	M)	m)	CR	Ω	·	ス	ヘ	ノ	ε
1 1 1 0	E	SO	*	.	N	\	n	-	SO	SP	·	セ	ホ	ズ	ε
1 1 1 1	F	SI	◊	/	O	-	o		SI	SP	·	ソ	ト	ο	ο

Note: SP is space code.

Don't use undefined codes.

The code charts of FONT \$ 11, 12....19 are not given in this appendix.
However, they are the same as the code charts of the "B₈ = 0" part of
FONTS \$ 1 - 9 combined with the "B₈ = 1" part of FONT \$ 10.

Code chart 2 FONT \$ 1, (ISO)

B ₈ = 0 (When using 8-bit code)								B ₈ = 1 (When using 8-bit code)							
S 1								S 0							
B ₇	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1
B ₆	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1
B ₅	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0
B ₄ B ₃ B ₂ B ₁	0	1	2	3	4	5	6	7	0(B)	1(9)	2(A)	3(B)	4(C)	5(D)	6(E)
0 0 0 0	0	SP	SP	0	@	P	·	p	SP	SP	-	♪	!	SP	!
0 0 0 1	1	·	!	1	A	Q	a	q	Γ	○	7	+	△	α	ρ
0 0 1 0	2	◊	#	2	B	R	b	r	Δ	「	イ	ソ	メ	β	σ
0 0 1 1	3	ETX	□	#	3	C	S	c	s	ETX	Z	」	ウ	テ	γ
0 1 0 0	4	△	□	4	D	T	d	t	(H)	·	エ	ト	タ	δ	υ
0 1 0 1	5	○	%	5	E	U	e	u	Λ	·	オ	ナ	ユ	ε	φ
0 1 1 0	6	⊗	&	6	F	V	f	v	(H)	『	カ	ニ	ヨ	ζ	χ
0 1 1 1	7	×	,	7	G	W	g	w	O	·	キ	ヌ	ラ	η	φ
1 0 0 0	8	BS	+	(H	X	h	x	BS	Π	·	ク	ネ	リ	δ
1 0 0 1	9	Y)	9	I	Y	i	y	Σ	·	ケ	ノ	ル	ε	γ
1 0 1 0	A	LF	◆	*	J	Z	j	z	LF	Υ	·	コ	ハ	レ	ζ
1 0 1 1	B	⊗	+	:	K	(k)	Φ	·	タ	ヒ	ロ	λ	ε
1 1 0 0	C	⊗	,	<	L	\	l		Ψ	·	シ	フ	フ	ν	ε
1 1 0 1	D	CR	⊗	-	M)	m)	CR	Ω	·	セ	ホ	ズ	ε
1 1 1 0	E	SO	*	.	N	\	n	-	SO	SP	·	ソ	ト	ο	ο
1 1 1 1	F	SI	◊	/	O	-	o		SI	SP	·	ο	ο	ο	ο

Note: SP is space code.

Don't use undefined codes.

Code chart 3 FONT \$ 2, (Japan)

B ₈ = 0 (When using 8-bit code)								B ₈ = 1 (When using 8-bit code)							
S1								S0							
B ₇	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1
B ₆	0	0	1	1	0	0	1	1	0	1	0	1	0	1	1
B ₅	0	1	0	1	0	1	0	1	0	1	0	1	0	1	1
B ₄ B ₃ B ₂ B ₁	0	1	2	3	4	5	6	7	0(B)	1(9)	2(A)	3(B)	4(C)	5(D)	6(E)
0 0 0 0	0	SP	SP	0	Ⓐ	P	'	p	SP	SP	-	♪	ゞ	SP	♪
0 0 0 1	1	.	!	1	A	Q	a	q	Γ	○	ア	チ	ム	ア	ア
0 0 1 0	2	◊	#	2	B	R	b	r	Δ	「	イ	ツ	メ	シ	シ
0 0 1 1	3	ETX	□	3	C	S	c	s	ETX	Z	」	ウ	テ	モ	モ
0 1 0 0	4	△	\$	4	D	T	d	t	Ⓑ	・	エ	ト	ヤ	リ	リ
0 1 0 1	5	○	%	5	E	U	e	u	Ⓐ	フ	オ	カ	ニ	ユ	ユ
0 1 1 0	6	☒	&	6	F	V	f	v	Ⓑ	○	フ	キ	ス	ラ	ラ
0 1 1 1	7	×	/	7	G	W	g	w	BS	Π	イ	ク	ネ	リ	リ
1 0 0 0	8	BS	+	(H	X	h	x	LF	Υ	。	ケ	ノ	ル	ル
1 0 0 1	9	Y)	9	I	Y	i	y	SO	SP	・	コ	ハ	レ	レ
1 0 1 0	A	LF	◆	:	J	Z	j	z	Φ	×	サ	ヒ	ロ	カ	カ
1 0 1 1	B	☒	+	:	K	{	k	{	Ψ	+	シ	フ	ワ	タ	タ
1 1 0 0	C	☒	,	<	L	\	l	:	CR	Ω	・	ス	ヘ	ソ	ソ
1 1 0 1	D	CR	✖	=	M)	m)	SO	SP	・	セ	ホ	ミ	ミ
1 1 1 0	E	SO	*	>	N	^	n	-	SI	SP	・	ソ	マ	ゼ	ゼ
1 1 1 1	F	SI	✿	?	O	-	o	-	SI	SP	・	ソ	マ	ゼ	ゼ

Note: SP is space code.
Don't use undefined codes.

Code chart 4 FONT \$ 3, (U.S.A.)

B ₈ = 0 (When using 8-bit code)								B ₈ = 1 (When using 8-bit code)							
S1								S0							
B ₇	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1
B ₆	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1
B ₅	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0
B ₄ B ₃ B ₂ B ₁	0	1	2	3	4	5	6	7	0(B)	1(9)	2(A)	3(B)	4(C)	5(D)	6(E)
0 0 0 0	0	SP	SP	0	Ⓐ	P	'	p	SP	SP	-	♪	ゞ	SP	♪
0 0 0 1	1	.	!	1	A	Q	a	q	Γ	○	ア	チ	ム	ア	ア
0 0 1 0	2	◊	#	2	B	R	b	r	Δ	「	イ	ツ	メ	シ	シ
0 0 1 1	3	ETX	□	3	C	S	c	s	ETX	Z	」	ウ	テ	モ	モ
0 1 0 0	4	△	\$	4	D	T	d	t	Ⓑ	・	エ	ト	ヤ	リ	リ
0 1 0 1	5	○	%	5	E	U	e	u	Ⓐ	フ	オ	カ	ニ	ユ	ユ
0 1 1 0	6	☒	&	6	F	V	f	v	Ⓑ	○	フ	キ	ス	ラ	ラ
0 1 1 1	7	×	/	7	G	W	g	w	BS	Π	イ	ク	ネ	リ	リ
1 0 0 0	8	BS	+	(H	X	h	x	LF	Υ	。	ケ	ノ	ル	ル
1 0 0 1	9	Y)	9	I	Y	i	y	SO	SP	・	コ	ハ	レ	レ
1 0 1 0	A	LF	◆	:	J	Z	j	z	Φ	×	サ	ヒ	ロ	カ	カ
1 0 1 1	B	☒	+	:	K	{	k	{	Ψ	+	シ	フ	ワ	タ	タ
1 1 0 0	C	☒	,	<	L	\	l	:	CR	Ω	・	ス	ヘ	ソ	ソ
1 1 0 1	D	CR	✖	=	M)	m)	SO	SP	・	セ	ホ	ミ	ミ
1 1 1 0	E	SO	*	>	N	^	n	-	SI	SP	・	ソ	マ	ゼ	ゼ
1 1 1 1	F	SI	✿	?	O	-	o	-	SI	SP	・	ソ	マ	ゼ	ゼ

Note: SP is space code.
Don't use undefined codes.

Code chart 5 FONT \$ 4, (Britain)

B ₈ = 0 (When using 8-bit code)								B ₈ = 1 (When using 8-bit code)							
S 1								S 0							
B ₇	0	0	0	0	1	1	1	0	0	0	0	1	1	1	1
B ₆	0	0	1	1	0	0	1	0	0	1	1	0	0	1	1
B ₅	0	1	0	1	0	1	0	1	0	1	0	1	0	1	1
B ₄	0	0	0	0	1	1	1	1	0	0	0	1	1	1	1
B ₃	0	0	1	1	0	0	1	1	0	0	1	1	0	1	1
B ₂	0	1	0	2	3	4	5	6	7	0(E)	1(G)	2(A)	3(B)	4(C)	5(D)
B ₁	0	1	2	3	4	5	6	7	0(F)	1(P)	2(R)	3(T)	4(S)	5(U)	6(V)
	SP	SP	0	@	P	'	p		SP	SP	-	タ	シ	ス	ヘ
	.	!	1	A	Q	a	q		Γ	ο	フ	シ	ム	ア	オ
	◊	"	2	B	R	b	r		Δ	フ	イ	ソ	メ	ブ	オ
	□	£	3	C	S	c	s		ETX	Z	」	ウ	テ	リ	ト
	△	\$	4	D	T	d	t		■	・	エ	ト	ナ	シ	ト
	×	%	5	E	U	e	u		Λ	・	オ	ナ	ニ	シ	ズ
	○	&	6	F	V	f	v		■	・	カ	ニ	ミ	ツ	ズ
	⊗	&	7	G	W	g	w		○	フ	チ	ヌ	ラ	リ	フ
	X	+	8	H	X	h	x		BS	Π	・	タ	ル	リ	ガ
	+	(9	I	Y	i	y		Σ	・	ケ	ノ	ル	レ	カ
	BS)	:	J	Z	j	z		LF	Υ	・	コ	ハ	ロ	カ
	Y	+	:	K	L	k	l		Φ	・	タ	ヒ	ロ	カ	ミ
	+	<	L	\	;	l	;		Ψ	・	シ	フ	ク	ク	ミ
	CR	=	M	;	m	}			CR	Ω	・	ス	ヘ	ノ	ミ
	SO	*	>	N	↑	n	-		SO	SP	・	セ	ホ	・	ミ
	SI	♂	?	O	-	o			SI	SP	・	ソ	マ	・	ミ

Note: SP is space code.
Don't use undefined codes.

Code chart 6 FONT \$ 5, (West Germany)

B ₈ = 0 (When using 8-bit code)								B ₈ = 1 (When using 8-bit code)							
S 1								S 0							
B ₇	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1
B ₆	0	0	1	1	0	0	0	1	0	0	1	1	0	0	1
B ₅	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0
B ₄	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1
B ₃	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1
B ₂	0	1	0	2	3	4	5	6	7	0(E)	1(G)	2(A)	3(B)	4(C)	5(D)
B ₁	0	1	1	7	8	9	10	11	12	0(F)	1(P)	2(R)	3(T)	4(S)	5(U)
	SP	SP	0	§	P	'	p		SP	SP	-	タ	シ	ス	ヘ
	.	!	1	A	Q	a	q		Γ	ο	フ	シ	ム	ア	オ
	◊	"	2	B	R	b	r		Δ	フ	イ	ソ	メ	ブ	オ
	□	£	3	C	S	c	s		ETX	Z	」	ウ	テ	リ	ト
	△	\$	4	D	T	d	t		■	・	エ	ト	ナ	ニ	ト
	⊗	%	5	E	U	e	u		Λ	・	オ	ナ	ニ	シ	ズ
	X	&	6	F	V	f	v		■	・	カ	ニ	ミ	ツ	ズ
	+	,	7	G	W	g	w		○	フ	チ	ヌ	ラ	リ	フ
	BS	+	(H	X	h	x		BS	Π	・	タ	ル	リ	ガ
	Y)	9	I	Y	i	y		Σ	・	ケ	ノ	ル	レ	カ
	+	:	;	J	Z	j	z		LF	Υ	・	コ	ハ	ロ	カ
	LF	:	:	K	Ä	k	ä		Φ	・	タ	ヒ	ロ	カ	ミ
	+	<	L	Ö	Ü	l	ö		Ψ	・	シ	フ	ク	ク	ミ
	CR	=	=	M	Ü	m	ö		CR	Ω	・	ス	ヘ	ノ	ミ
	SO	*	*	>	N	^	n		SO	SP	・	セ	ホ	・	ミ
	SI	♂	?	O	-	o			SI	SP	・	ソ	マ	・	ミ

Note: SP is space code.
Don't use undefined codes.

Code chart 7 FONT \$ 6. (France)

B ₈ = 0 (When using 8-bit code)								B ₈ = 1 (When using 8-bit code)							
S 1								S 0							
B ₇	0	0	0	0	1	1	1	0	0	0	0	1	1	1	0
B ₆	0	0	1	1	0	0	1	0	0	1	1	0	0	1	1
B ₅	0	1	0	1	0	1	0	0	1	0	1	0	1	1	1
B ₄ B ₃ B ₂ B ₁	0	1	2	3	4	5	6	7	0(8)	1(9)	2(A)	3(B)	4(C)	5(D)	6(E)
0 0 0 0	0	SP	SP	0	À	P	‘	’	SP	SP	—	♪	!	SP	7(F)
0 0 0 1	1	.	!	1	A	Q	à	á	Γ	○	?	チ	ム	α	δ
0 0 1 0	2	◊	#	2	B	R	b	r	Δ	「	イ	ノ	メ	γ	ε
0 0 1 1	3	ETX	□	£	3	C	S	c	ETX	Z	」	ケ	テ	モ	θ
0 1 0 0	4	△	\$	4	D	T	d	t	Λ	・	エ	ト	ナ	δ	τ
0 1 0 1	5	○	%	5	E	U	e	u	Ω	ヲ	オ	カ	ニ	ヨ	υ
0 1 1 0	6	⊗	&	6	F	V	f	v	BS	Π	‘	キ	ス	ラ	ζ
0 1 1 1	7	X	/	7	G	W	g	w	Σ	Σ	♪	タ	ス	リ	η
1 0 0 0	8	BS	+	(H	X	h	x	LF	Υ	?	コ	ノ	ル	ω
1 0 0 1	9	Y)	9	I	Y	i	y	Φ	Φ	+	+	ハ	レ	ε
1 0 1 0	A	LF	Φ	:	J	Z	j	z	Ψ	Ψ	+	+	ヒ	ロ	λ
1 0 1 1	B	X	+	;	K	O	k	o	CR	Ω	♪	シ	フ	フ	ρ
1 1 0 0	C	⊗	,	<	L	C	l	o	SO	SP	*	セ	ホ	ξ	ε
1 1 0 1	D	CR	-	=	M	Å	m	—	SI	SP	♪	♪	ア	ο	ο
1 1 1 0	E	SO	*	>	N	Ä	n	—							
1 1 1 1	F	SI	◊	/	O	—	o	—							

Note: SP is space code.

Don't use undefined codes.

Code chart 8 FONT \$ 7. (Sweden)

B ₈ = 0 (When using 8-bit code)								B ₈ = 1 (When using 8-bit code)							
S 1								S 0							
B ₇	0	0	0	0	1	1	1	0	0	0	0	1	1	1	1
B ₆	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1
B ₅	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0
B ₄ B ₃ B ₂ B ₁	0	1	2	3	4	5	6	7	0(8)	1(9)	2(A)	3(B)	4(C)	5(D)	6(E)
0 0 0 0	0	SP	SP	0	@	P	‘	’	SP	SP	—	タ	シ	SP	π
0 0 0 1	1	.	!	1	A	Q	à	á	Γ	○	?	チ	ム	α	δ
0 0 1 0	2	◊	#	2	B	R	b	r	Δ	「	イ	ノ	メ	γ	ε
0 0 1 1	3	ETX	□	£	3	C	S	c	ETX	Z	」	ケ	テ	モ	θ
0 1 0 0	4	△	\$	4	D	T	d	t	Λ	・	エ	ト	ナ	δ	τ
0 1 0 1	5	○	%	5	E	U	e	u	Ω	ヲ	オ	カ	ニ	ヨ	υ
0 1 1 0	6	⊗	&	6	F	V	f	v	BS	Π	‘	キ	ス	ラ	ζ
0 1 1 1	7	X	/	7	G	W	g	w	Σ	Σ	♪	タ	ス	リ	η
1 0 0 0	8	BS	+	(H	X	h	x	LF	Υ	?	コ	ノ	ル	ω
1 0 0 1	9	Y)	9	I	Y	i	y	Φ	Φ	+	+	ハ	レ	ε
1 0 1 0	A	LF	Φ	:	J	Z	j	z	Ψ	Ψ	+	+	ヒ	ロ	λ
1 0 1 1	B	X	+	;	K	O	k	o	CR	Ω	♪	シ	フ	フ	ρ
1 1 0 0	C	⊗	,	<	L	C	l	o	SO	SP	*	セ	ホ	ξ	ε
1 1 0 1	D	CR	-	=	M	Å	m	—	SI	SP	♪	♪	ア	ο	ο
1 1 1 0	E	SO	*	>	N	Ä	n	—							
1 1 1 1	F	SI	◊	/	O	—	o	—							

Note: SP is space code.

Don't use undefined codes.

Code chart 9 FONT \$ 8, (Denmark)

B ₈ = 0 (When using 8-bit code)								B ₈ = 1 (When using 8-bit code)								
S 1								S 0								
B ₇	0	0	0	0	1	1	1	0	0	0	1	1	1	1	0	
B ₆	0	0	1	1	0	0	1	1	0	0	1	1	0	1	1	
B ₅	0	1	0	1	0	1	0	1	0	1	0	1	0	1	1	
B ₄	0	1	2	3	4	5	6	7	0(B)	1(B)	2(A)	3(B)	4(D)	5(D)	6(E)	
B ₃	0	1	SP	SP	0	@	P	'	0	SP	SP	-	9	1	SP	
B ₂	0	0	0	1	.	!	A	Q	a	q	g	o	z	l	+	
B ₁	0	0	1	2	◇	#	B	R	b	r	Δ	g	z	4	x	
B ₀	0	0	0	2	ETX	£	3	C	S	c	ETX	Z	J	2	x	
	0	0	1	3	△	\$	4	D	T	d	△	^	^	4	x	
	0	0	0	4	○	%	5	E	U	e	Λ	.	^	4	x	
	0	1	0	5	⊗	&	6	F	V	f	⊗	,	^	4	x	
	0	1	0	6	X	,	7	G	W	g	○	,	^	4	x	
	0	1	1	7	+	(8	H	X	h	BS	Π	+	4	x	
	0	1	1	8	BS)	9	I	Y	i	BS	Σ	+	4	x	
	0	0	0	9	Y	,	;	J	Z	j	LF	Υ	+	4	x	
	1	0	1	0	LF	*	:	K	Æ	k	LF	Φ	*	+	4	x
	1	0	1	A	×	:	;	L	Ø	l	CR	Ω	*	+	4	x
	1	0	1	B	⊗	,	<	M	À	m	CR	Ω	*	+	4	x
	1	0	0	C	⊗	-	=	N	^	n	SO	SP	*	+	4	x
	1	1	0	D	CR	*	>	N	~	-	SO	SP	*	+	4	x
	1	1	1	E	SO	*	?	O	-	o	SI	SP	*	+	4	x
	1	1	1	F	SI	⊗	/				SI	SP	*	+	4	x

Note: SP is space code.
Don't use undefined codes.

Code chart 10 FONT \$ 9, (Spain)

B ₈ = 0 (When using 8-bit code)								B ₈ = 1 (When using 8-bit code)							
S 1								S 0							
B ₇	0	0	0	0	1	1	1	0	0	0	0	1	1	1	1
B ₆	0	0	1	1	0	0	0	1	1	0	1	1	0	1	1
B ₅	0	1	0	0	1	0	1	0	1	0	1	0	1	0	1
B ₄	0	1	2	3	4	5	6	7	0(B)	1(B)	2(A)	3(B)	4(D)	5(D)	6(E)
B ₃	0	1	SP	SP	0	@	P	'	0	SP	SP	-	9	1	SP
B ₂	0	0	0	1	.	!	A	Q	a	q	g	o	z	l	+
B ₁	0	0	1	2	◇	#	B	R	b	r	Δ	g	z	4	x
B ₀	0	0	0	2	ETX	£	3	C	S	c	ETX	Z	J	2	x
	0	0	1	3	△	\$	4	D	T	d	△	^	^	4	x
	0	1	0	4	○	%	5	E	U	e	Λ	.	オ	ニ	0
	0	1	0	5	⊗	&	6	F	V	f	⊗	カ	ニ	3	z
	0	1	1	6	X	,	7	G	W	g	○	7	ス	ラ	-
	0	1	1	7	+	(8	H	X	h	BS	Π	+	タ	0
	1	0	0	8	BS)	9	I	Y	i	BS	Σ	+	ケ	0
	1	0	0	9	Y	,	;	J	Z	j	LF	Υ	+	コ	1
	1	0	1	0	LF	*	:	K	í	k	LF	Φ	*	ヒ	1
	1	0	1	A	×	:	<	L	Ñ	l	CR	Ω	*	シ	1
	1	1	0	B	⊗	,	=	M	í	m	CR	Ω	*	ス	1
	1	1	0	C	⊗	-	>	N	^	-	SO	SP	*	ヘ	1
	1	1	0	D	CR	*	?	O	-	o	SO	SP	*	ホ	1
	1	1	1	E	SO	*	/				SI	SP	*	オ	1
	1	1	1	F	SI	⊗					SI	SP	*	オ	1

Note: SP is space code.
Don't use undefined codes.

Code chart II FONT & 10

B ₈ = 0 (When using 8-bit code)								B ₈ = 1 (When using 8-bit code)							
S I								S O							
B ₇	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1
B ₆	0	0	1	1	0	0	1	1	0	0	1	1	0	1	1
B ₅	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0
B ₄ B ₃ B ₂ B ₁	0	1	2	3	4	5	6	7	0(B)	1(9)	2(A)	3(B)	4(C)	5(D)	6(E)
0 0 0 0	0	SP	SP	0	©	F	-	P	SP	II	SP	*			
0 0 0 1	1	.	!	1	A	Q	a	q		A	P	a			
0 0 1 0	2	◊	#	2	B	R	b	r		B	Σ	β			
0 0 1 1	3	ETX	□	#	3	C	S	s		ETX	T	r	τ		
0 1 0 0	4	△	\$	4	D	T	d	t			Δ	δ	τ		
0 1 0 1	5	○	%	5	E	U	e	u			E	Φ	ε	υ	
0 1 1 0	6	☒	&	6	F	V	f	v			Z	X	ζ	ς	
0 1 1 1	7	☒	*	7	G	W	g	w			H	Ψ	η	ζ	
1 0 0 0	8	BS	+	8	H	X	h	x	BS		Ω	Ω	φ	ω	
1 0 0 1	9	Y)	9	I	Y	i	y			I	i	ς	ς	
1 0 1 0	A	LF	+	:	J	Z	j	z	LF		K	κ	λ	λ	
1 0 1 1	B	☒	+	;	K	(k	{			A	λ	±	±	
1 1 0 0	C	☒	*	<	L	\	l	:			M	μ	ε	ε	
1 1 0 1	D	CR	—	=	M)	m	}	CR		N	ν	τ	τ	
1 1 1 0	E	SO	*	>	N	†	n	~	SO		Ω	ε	∞	∞	
1 1 1 1	F	SI	♂	/	O	—	o	—	SI		O	ο	ο	ο	

Note: SP is space code.

Don't use undefined codes.

1. INTRODUCTION TO PROGRAMMING

The plotter can draw diagrams very easily, according to data sent from a computer.

Examples of programs which provide basic plotting, using standard BASIC, are given below. The program examples use the data output statement LPRINT for a Centronics interface. If you are using another interface, or a computer which cannot output LPRINT (FM-8, IF800, etc.), modify the programs partially. See Part 1 for descriptions of all the commands and parameters, as well as how to combine them in the program examples. GP.GL commands are used in these examples.

1-1. Plotting of straight lines

1-1-1. How to use the basic commands

First, try drawing a triangle using two basic commands: the MOVE command which moves the pen when it is raised, and the DRAW command which draws straight lines.

Refer to your computer's manual for how to key in the program and operate the computer:

N E W [RETURN]

This erases the previous program.

Program entry

Key in the program starting from line 10. Always press the [RETURN] key at the end of each line.

L I S T [RETURN]

This displays the program listing on the CRT screen.

Check program

Check for typing errors.

Check settings

Check that the cables of the computer and plotter are connected, the plotter's paper and pen(s) are set, and the plotter is switched on.

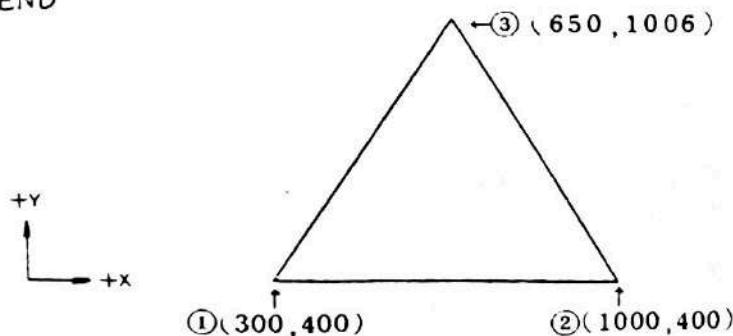
R U N [RETURN]

This runs the program.

Plotting

• Program listing

```
10 REM * SAMPLE2-1-1 *
20 E$=CHR$(3)
30 LPRINT "M300.400."
40 LPRINT "D1000.400.650.1006.300.400";E$
50 END
```



Plotting example

OUTLINE

This section is for reference when in HP-GL™ emulation mode. The HP-GL emulation specifications given in this section are fully compatible with HP7475A at the command level. Set bits 6 and 7 of the DIP switch 2.

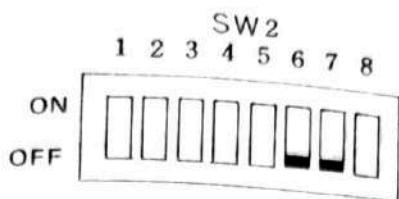


Fig. 1-1 Setting the DIP switches for HP-GL™ emulation mode.

2. RS-232-C interface control commands

2-1. Description of commands

Table 2-1 Table of interface control commands

No.	Command	Command format	Function
1	ESC. (ESC. (Turns plotter on
	ESC.Y	ESC. Y	Turns plotter on
2	ESC.)	ESC.)	Turns plotter off
	ESC. Z	ESC. Z	Turns plotter off
3	ESC. @	ESC. @ <DEC>; <DEC>:	Specification of ER line and buffer size
4	ESC. B	ESC. B	Output of buffer space available
5	ESC. E	ESC. E	Output of error status
6	ESC. H	ESC. H <DEC>; <ASC>;	Specification of handshake mode 1
7	ESC. I	ESC. I <DEC>; <ASC>;	Specification of handshake mode 2
8	ESC. J	ESC. J	Interface command inhibition
9	ESC. K	ESC. K	Buffer clear
10	ESC. L	ESC. L	Output of buffer size
11	ESC. M	ESC. M <DEC>; <ASC>;	Specification of output mode
12	ESC. N	ESC. N <DEC>; <ASC>;	Specification of output mode
13	ESC. O	ESC. O	Output of status
14	ESC. R	ESC. R	Handshake command initialization

(1) Plotter on

[ESC.J] or [ESC.Y]

These put the plotter on-line.

(2) Plotter off

[ESC.J] or [ESC.Z]

These put the plotter off-line.
(The plotter is on-line when the power is turned on)

(3) Specification of ER line and buffer size

[ESC.@ <DEC>;<DEC>:]

<DEC> Specification of maximum buffer size

● MP4100, MP4200

Any value from 0 to 5120 bytes can be specified.
(initial setting: 5120 bytes)

● MP4300, MP4400

When the pen sorting is set to on:

Any value from 0 to 10240 bytes can be specified.
(initial setting: 10240 bytes)

When the pen sorting is set to off:

Any value from 0 to 35840 bytes can be specified.
(initial setting: 35840 bytes)

<DEC>

Control of ER (Data terminal ready)

ER is always on when the least significant bit is 0, and is controlled when 1.

When controlled, ER goes on if the space available in the buffer is

larger than the current block size, and goes off if not.

(Initial setting: Bit 1 = 1)

(4) Output of buffer space available

[ESC.B]

This outputs the buffer space available.

Responses

<DEC>

Decimal value between 10240 to 0, indicates the currently available buffer space.

When the actual buffer size is larger than 1024, 1024 is always output from the plotter.

[TERM]

Terminator. If no terminator has been specified by an ESC.M command, CR (Carriage Return) functions as the terminator.

(6) Output of error status
[ESC.E]
This outputs the interface error status.

Response
<DEC> A decimal value between 0 to 16, indicating the following error statuses, is output in response.

Table 2-2 Error statuses

Error No.	Meaning
0	No error
10	Output command received while another was being processed
11	Unclear byte received after ESC.
12	A byte of interface control command parameters is unclear
13	Parameter overflow
14	Too many parameters received
15	Framing, parity or overrun error
16	Input buffer overflow

(6) Specification of handshake mode 1

[ESC.H <DEC>; <ASC>; <ASC> (.....<ASC>);]

The parameters are the same as those for ESC.I (Handshake mode 2 specification). However, the usage of the parameters specified by ESC.M or ESC.N differ.

Table 2-3 Handshake modes

Parameter	Handshake response or X-on trigger character		Output Command response
	Mode 1	Mode 2	
Turnaround delay	O	O	O
Output trigger character	O	X	O
Echo terminator	O	X	O
Output terminator	O	X	O
Intercharacter delay	O	O	O

O Effective
X Not effective

(7) Specification of handshake mode 2

[ESC.I <DEC>; <ASC>; <ASC> (;.....<ASC>);]

<DEC>

- This is the level at which X-off is output in X-on/off handshake mode.

- The X-on output level is:

Max. buffer size 1/2 when X-off is 1/2 or less of the max. buffer size
X-off output level + 1 when X-off is more than 1/2 of the max. buffer size
Initial setting is 80 bytes.

- This specifies the data block size in ENQ/ACK handshake mode.
Initial setting is 80 bytes.

<ASC> Initial setting: 0 (null)

- Always 0 in X-on/X-off handshake mode.

- This specifies the ENQ character when in ENQ/ACK handshake mode. The character must be within the range of 1- 127, 0 cannot be specified. The 5 is usually used.

<ASC> Any characters between 1 and 10 can be specified.

<ASC> Any value from 0 to 127 can be specified by the characters.

- This specifies the X-on trigger character in X-on/X-off handshake mode.

- This specifies the handshake response character in ENQ/ACK handshake mode. 6 (the ACK character) is usually used.

(8) Interface command inhibition

[ESC.J]

This inhibits the interface handshake control, the plotter stops the data output and waits for an echo character, for example.

(9) Buffer clear

[ESC.K]

This clears all the data within the buffer and stops the plotting.

(10) Output of buffer size
[ESC.L]

The plotter waits until a buffer space equivalent to the max. Buffer size specified by an ESC.L command is available, and then responds with the buffer size.

Responses

<DEC> Buffer size expressed as decimal value

[TERM] Terminator. If not specified, CR (Carriage Return) is used as terminator.

(11) Specification of output mode 1
[ESC.M <DEC>; <ASC>; <ASC>; <ASC>; <ASC>; <ASC>;]

This specifies the conditions for data output.

<DEC> Turnaround delay (0 - 9999 msec)
This specifies delay before output starts.
Initial setting is 0.

<ASC> Output trigger character.
This specifies the character used to start output.
Initial setting is 0.

<ASC> Echo terminator character
This character specifies the restart of input after output.
Initial setting is 0.

<ASC> These specify the terminators for output data, one or two characters can be specified as terminators. Any values between 1 - 127 can be used, 0 is not valid.
Initial setting is 13; 0 (CR - Carriage Return - only)

(12) ESC.N Specification of output mode 2

[ESC.N <DEC>;<ASC>;(.....<ASC>);]

This specifies the conditions for data output.

<DEC> Intercharacter delay (0 - 999 msec)

This specifies the delay between characters in data output.
Initial setting is 0.

<ASC> Any characters between 1 and 10 can be specified.

<ASC>

- In X-on/X-off handshake mode, this specifies the X-off trigger character
- In ENQ/ACK handshake mode, this specifies the initial character response

(13) ESC.O Output of status

[ESC.O]

This outputs the plotter status.

<DEC> 0-Buffer is not empty.

8-Buffer is empty and ready for data.

16-View status. Paper is loaded but graphics are suspended.
[TERM] Terminator. If not specified, CR (Carriage Return) is used as ter.

(14) ESC.R Command initialization

[ESC.R]

This returns the parameters for handshake control to their initial values.

2.2 Examples of handshake control programs

- (1) Hardwire handshake mode: Sample program is omitted.
(2) X-On/X-Off handshake mode

In case X-On/X-Off handshake mode has been set by the DIP switches or by SOFT KEY
input:

```
    'XON/OFF hand - shake
10  OPEN" COM1 : 9600,E,7,2,RS,CS65535,DS,CD" A$#1
20
30  C=1: ' output counter
40
50  ON COM GOSUB 250: ' interrupt
60
70  PRINT #1, " PU,PA0,0;;"
80
90  COM ON      : ' start '
100 'data output routine
110 FOR M=1 TO 45
120 FOR N=1 TO 65
130 PRINT #1, "PD;PR200,0,0,200,-200,0,0,-200;PU;PR240,0;;"
140 PRINT C;;C=C+1
150 NEXT N
160 PRINT #1, "PU;PR-15600, 240;;"
170 NEXT M
180 CLOSE
190 END
210
250 ' interrupt routine
260 IF LOC(1)=0 THEN RETURN
270
280 A$ = INPUT$(1,#1)
290 IF A$ = CHR$(17) THEN RETURN
300 IF A$ = CHR$(19) THEN 310 ELSE 350
310 FOR I=1 TO 100:NEXT I
320 PRINT "WAIT"
330 GOTO 280
340
350 PRINT "I/O ERROR"
360 STOP
370 END
```

(b) In case of performing X-On/X-Off control in hardwire handshake mode:

```
10 'XON-OFF CHARACTER handshake
20 OPEN"COM1:9600,E,7,2,RS,CS65535,DS,CD"AS#1
30 '
40 C=1      : ' output counter
50 ON COM GOSUB 250
60 '
70 PRINT #1,"PU;PA0,0;"
80 PRINT #1,CHR$(27); "I100;;17;;"
90 PRINT #1,CHR$(27); "N5;19;;"
100 PRINT #1,CHR$(27); "N5;19;;"
110 PRINT #1,CHR$(27); "N5;19;;"
120 '
130 COM ON
140 '
150 'data output routine
160 '
170 PRINT #1,"PU;PR40,40;;"
180 PRINT #1,"PD;PR400,0,0,400,-400,0,0,-400;;"
190 PRINT C;:C=C+1
200 '
210 IF C<300 THEN 220
220 CLOSE
230 END
240 '
250 'interrupt routine
260 IF LOC(1)=0 THEN RETURN
270 '
280 A$=INPUT$(1,#1)
290 IF A$=CHR$(17) THEN RETURN
300 IF A$=CHR$(19) THEN 310 ELSE 340
310 FOR I=1 TO 100:NEXT I
320 PRINT "WAIT"
330 GOTO 280
340 PRINT "I/O ERROR"
350 STOP
360 END
```

(3) ENQ/ACK handshake mode
in case ENQ/ACK handshake mode has been set by the DIP switches or by serial key
(4) input:

```
10 ' ENQ/ACK hand - shake
20 OPEN "COM1 : 9600, E, 7, 2, RS, CS 65535, DS, CD" AS#1
30 '
40 '
50 C=1
60 '
70 PRINT #1, " PU; PA0, 0 ; "
80 '
90 CMDA$ = " PR400,0,0,400,-400,0,0,-400;."
100 '
110 C=C+1: PRINT " DATA=" ; C
120 GOSUB 160
130 GOTO 120
140 '
150 '
160 PRINT #1, CHR$(5);
170 LINE INPUT #1,A$
180 '
190 IF A$=CHR$(6) THEN 220
200 '
210 goto 170
220 PRINT #1,CMDA$
230 RETURN
```

(b) In case of performing ENQ/ACK control in hardwire handshake mode.

```
10 'ENQ/ ACK hand-shake
20 '
30 OPEN "COM1": 9600, E, 7, 2, RS, CS 65535, DS, CD" AS#1
40 '
50 C = 1
60 '
70 PRINT #1, "PU; PA0, 0;"
80 '
90 PRINT #1, CHR$(27); ".M250;" ;
100 PRINT #1, CHR$(27); ".N5;" ;
110 PRINT #1, CHR$(27); ".H100;5;6;" ;
120 '
130 ' data output routine
140 '
150 GOSUB 270
160 '
170 PRINT #1, "PU; PR40, 40;" ;
180 PRINT #1, "PD; PR400, 0, 0, 400, -400, 0, 0, -400;" ;
190 PRINT C; : C=C+1
200 '
210 IF C<300 THEN 130
220 '
230 CLOSE
240 END
250 '
260 '
270 PRINT #1, CHR$(5);
280 A$=INPUT$(1, #1)
290 IF A$=CHR$(6) THEN 280
300 IF A$=CHR$(13) THEN RETURN
310 FOR I=1 TO 100: NEXT I
320 PRINT "WAIT"
330 GOTO 280
```

(c) In case of performing ENQ/ACK echo control in hardwire handshake mode

```
10  ENQ/ACK - ECHO
10  OPEN"COM1:9600,E,7,2,RS,CS65535,DS,CD,A9#1
20
30  C=1
40
50  ON COM GOSUB 300
60
70  PRINT #1,CHR$(27);".M250;17;10;13;."
80  PRINT #1,CHR$(27);".H100;5;6;."
90  PRINT #1,CHR$(5);CHR$(17);".N5
100
110 COM ON
120
130 ' data out routine
140
150 IF A$=CHR$(13) THEN GOTO 200
160 FOR I=1 TO 100:NEXT I
170 PRINT "WAIT"
180 GOTO 160
190
200 PRINT #1,CHR$(10);
210 A$=CHR$(0)
220 PRINT #1,"PU;PR40,40;."
230 PRINT #1,"PD;PR400,0,0,400,-400,0,0,-400;."
240 PRINT C;:C=C+1
250
260
270 IF C<300 THEN 100
280 CLOSE
290 END
300
310 ' interrupt routine
320 IF LOC(1)=0 THEN RETURN
330
340 A$=INPUT$(1,#1)
350 IF A$=CHR$(6) OR A$=CHR$(13) THEN PRINT #1,A$;
360 IF A$=CHR$(6) OR A$=CHR$(13) THEN RETURN
370
380 PRINT "I/O ERROR"
390 STOP
400 END
```

(4) Sample program for checking the handshaking

```
WAIT PRINT #1,CHR$(27):"~B"
LINE INPUT #1,A$
IF A$=CHR$(255) THEN DATAOUT
GOTO WAIT

DATAOUT
PRINT #1,D$,
```

3. DESCRIPTION OF COMMANDS

3.1 Numerical parameters

The numerical parameters for the plotter units, angle, and frequency can be specified using whole numbers ranging from -32767 to +32767 (MP4100, MP4200) or -2²³ to +2²³ (MP4300, MP4400).

Note, however, that any value that would cause the difference in the distance between two points to exceed 32767 (MP4100, MP4200) or 8388607 (MP4300, MP4400) cannot be used.

For the user units, decimal-point values that fall within the above range can be used.

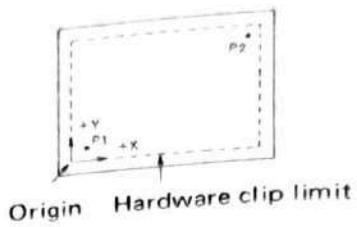
For more information on plotter units and user units, see the SC command.

3.2 Initial plotter settings

Table 3-2

Functions	Equivalent Command	Status
Alternative character set	CA0;	Set to character set 0.
Standard character set	CS0;	Set to character set 0.
Digitize mode	DC;	DP command is cleared.
Direction of writing	DI1,0;	Horizontal
Label terminator	DT ETX	ETX (ASCII decimal code 3)
Mask values	IM223;	All errors recognized.
Window	IW;	Set to the plotter's mechanical limits.
Line type	LT;	Solid line (pattern length: 4% of the P1-P2 distance)
Scaling	SC;	No scaling
Character slant	SL;	Set to 0.
Symbol mode	SM;	Off
Character size	SR;	Character width : 0.75% of P2x - P1x or Character height: 1.50% of P2y - P1y or Standard character set selected.
Character set	SS;	Ticks on X-axis: 0.5% of P2y - P1y
Graduation (tick) length	TL;	Ticks on Y-axis: 0.5% of P2x - P1x
Rotation of coordinate system	RO0;	Rotation angle of coordinate system to 0°
Scaling points	IP;	P1, P2 set to standard values.
Plotting mode	PA;	Pen moves based on absolute coordinate values.
Pen up/down status	PU;	Pen is raised.
Type of shading	FT;	Set to type 1 (solid bidirectional filling).
Line spacing of shading	FT;	Set to 1% of the diagonal distance between P1 and P2.
Angle of shading	FT;	Set to 0 (horizontal).
Thickness of inked lines	PT;	Set to 0.3 mm.
Vertical label direction	DV;	Horizontal
Label origin	LO1;	Current pen position is set as label origin.
Pen speed	VS;	Set to the maximum speed of the current pen.
Paper size	PS;	Mechanical limits set by the DIP switches.

3.3 Plotting area
The plotting area is set by the scaling points P1 and P2.



Paper size	P1x	P1y	P2x	P2y	Maximum plotting area
ANSI B	522	259	15722	10259	416mm x 268mm
ISO A3	170	602	15370	10602	404mm x 285mm
EXPAND	200	200	17080	11680	432mm x 297mm

3.4 Description of commands

VECTOR GROUP

AA

ARC ABSOLUTE command: Absolute-coordinate arc command

Command symbol:

Function:

Input format:

Statement example:

Parameter definitions:

Parameter ranges:

Related commands:

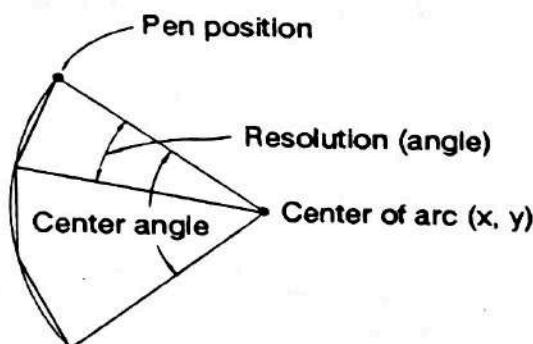
Description:

AA

Draws an arc centered on the point specified by absolute coordinates.

AAx, y, θ, (, φ) ;**PRINT#1, "AA1000, 1000, 60(, 5);"****x,y:** Specifies the center of the arc in absolute coordinates.**θ :** Specifies the center angle of the arc.**φ :** Specifies the resolution. $-32767 \leq x \leq 32767$ (MP4100, 4200) $-2^{23} \leq y \leq 2^{23}-1$ (MP4300, 4400) $-32767 \leq \theta \leq 32767$ (MP4100, 4200) $-2^{23} \leq \theta \leq 2^{23}-1$ (MP4300, 4400) $-32767 \leq \varphi \leq 32767$ (MP4100, 4200) $-2^{23} \leq \varphi \leq 2^{23}-1$ (MP4300, 4400)**AR, CI, LT**

The AA command draws an arc centered on the point given by x, y and with the specified center angle (θ) and resolution (φ), starting from the current pen position.



Specify the center angle of the arc in degrees. The arc is drawn counterclockwise if the center angle has a positive value, or clockwise if it has a negative value.

The distance between the pen position when the AA command was received and the center point specified by the x and y coordinates is taken as the radius of the arc. The radius cannot be specified directly. The resolution is the same as that of the CI command.

AR

ARC RELATIVE command: Relative-coordinate arc command

Command symbol:

Function:

Input format:

Statement example:

Parameter definitions:

Parameter ranges:

Related commands:

Description:

AR

Draws an arc centered on the point specified by relative coordinates.

AR $\Delta x, \Delta y, \theta(, \varphi);$

PRINT#1, "AR1000, 1000, 60(, 5);"

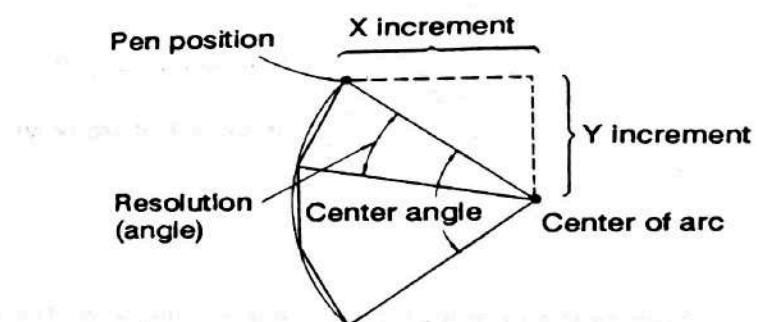
$\Delta x, \Delta y$: Specifies the center of the arc in relative coordinates.
 θ : Specifies the center angle of the arc.
 φ : Specifies the resolution.

 $-32767 \leq \Delta x \leq 32767$ (MP4100, 4200) $-2^{23} \leq \Delta y \leq 2^{23}-1$ (MP4300, 4400) $-32767 \leq \theta \leq 32767$ (MP4100, 4200) $-2^{23} \leq \theta \leq 2^{23}-1$ (MP4300, 4400) $-32767 \leq \varphi \leq 32767$ (MP4100, 4200) $-2^{23} \leq \varphi \leq 2^{23}-1$ (MP4300, 4400)

AA, CI, LT

The Δx and Δy increment parameters determine the direction of the center of the arc. Positive values set the center of the arc in the positive direction (upward or to the right) and negative values set it in the negative direction (downward or to the left).

The distance between the pen position when the AR command was received and the point specified by the $\Delta x, \Delta y$ coordinates is taken as the radius of the arc. The radius cannot be specified directly. The resolution is the same as that of the CI command.



CI

CIRCLE command: Circle plotting command

Command symbol:

CI

Function:

Draws a circle of any desired radius.

Input format:

CIr(, φ);

Statement example:

PRINT#1, "CI3000, 5;"

Parameter definitions:

 r : Specifies the radius from the point at which the CI command was received. φ : Specifies the resolution.

Parameter ranges:

 $-32767 \leq r \leq 32767$ (MP4100, 4200) $-2^{23} \leq r \leq 2^{23}-1$ (MP4300, 4400) $-32767 \leq \varphi < 32767$ (MP4100, 4200) $-2^{23} \leq \varphi < 2^{23}-1$ (MP4300, 4400)

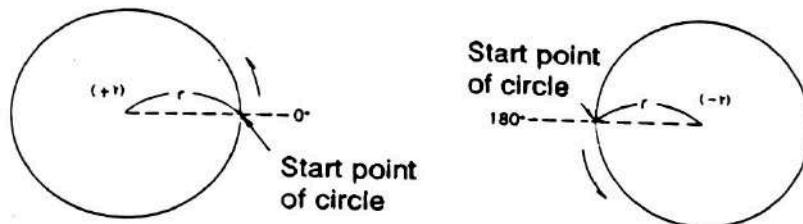
Related commands:

LT, SC, WG

Description:

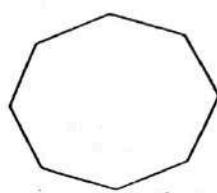
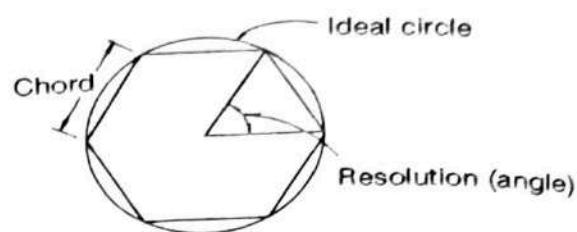
When the CI command is received, the plotter draws a circle centered on the current pen position and with the specified radius and resolution.

The CI command does not need a PD (Pen Down) command. When the CI command is received, the plotter raises the pen and moves it to the start point of the circle, then lowers it and draws the circle. When it has drawn the circle, it raises the pen again and returns it to where it was when the CI command was received (the center of the circle).

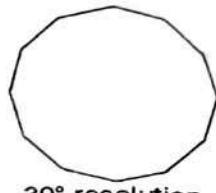


The circle is drawn starting from the 0° point when the radius is specified as a positive integer, and from the 180° point when it is specified as a negative integer.

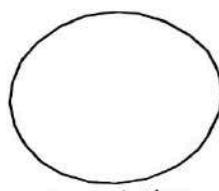
As shown in the figure below, the circle is drawn as a series of connected straight line segments. By varying the resolution parameter, a variety of "circles" ranging from polygons to smooth circles can be drawn. The resolution is set to 5° if not otherwise specified.



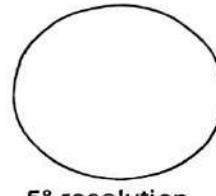
45° resolution



30° resolution



15° resolution



5° resolution

PA**PLOT ABSOLUTE command: Absolute-coordinate movement command**

Command symbol:

PA

Function:

Moves the pen to the specified coordinates.

Input formats:

PAx1, y1 (, ..., ..., xn, yn);

Statement example:

PRINT#1, "PA2000, 1500;"

Parameter definitions:

x, y: Specify the absolute coordinates to which the pen moves.

Parameter range:

 $-32767 \leq x \leq 32767$ (MP4100, 4200) $-2^{23} \leq y \leq 2^{23}-1$ (MP4300, 4400)

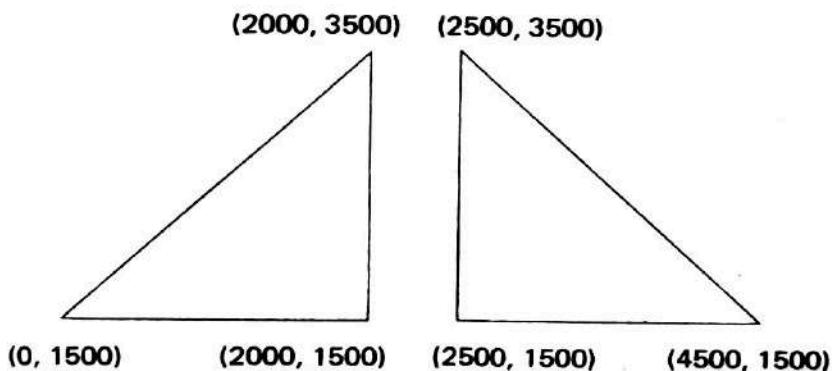
Related commands:

PR

Description:

The PA command moves the pen to the point specified by the x- and y-coordinate parameters. Specify pairs of parameters in succession after PA: the pen moves to the specified points in the same order.

PU and PD can be used as parameters within a PA command. If the parameters are omitted, the pen does not move and its status remains the same.

(Example)**IN:****PA2000, 1500; PD0, 1500, 2000, 3500, 2000, 1500; PU2500, 1500; PA; PD4500, 1500, 2500, 3500, 2500, 1500;***Absolute-coordinate movements*

PU

PEN UP command: Pen control command

PD

PEN DOWN command: Pen control command

Command symbols:

PU
PD

Functions:

The PU command raises the pen at its current position.
The PD command lowers the pen at its current position.

Input formats:

PU; PUx, y;
PD; PDX, y;

Statement examples:

PRINT#1, "PU0, 1500;"
PRINT#1, "PD0, 1500;"

Parameter range:

 $-32767 \leq x \leq 32767$ (MP4100, 4200)
 $-2^{23} \leq y \leq 2^{23}-1$ (MP4300, 4400)

Related commands:

PA, PR

Description:

When one of these commands is received, the plotter moves the pen, raised or lowered as appropriate, to the point specified by the x and y parameters.

If the parameters are omitted, the pen is just raised or lowered at its current position. Use this function in combination with the PA, PR and other commands.

With the PD command, the specification of the LT command becomes valid.

PR

PLOT RELATIVE command: Relative-coordinate movement command

Command symbol:

PR

Function:

Moves the pen to the coordinates specified by x and y increments.

Input formats:

PR $\Delta x_1, \Delta y_1, \dots, \Delta x_n, \Delta y_n$;
PR;

Statement example:

PRINT#1, "PRO, 1500;"

Parameter definitions:

x,y: Move the pen by the relative x and y coordinates.

Parameter range:

 $-32767 \leq \frac{\Delta x}{\Delta y} \leq 32767$ (MP4100, 4200)

Related commands:

PA

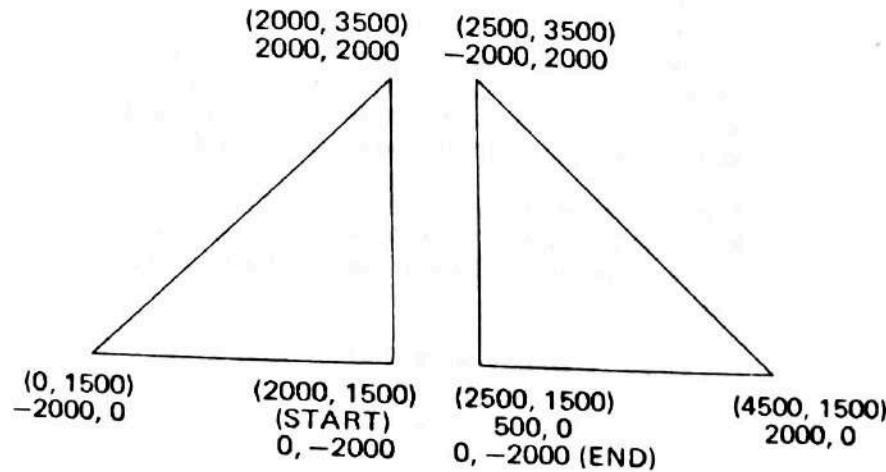
Description:

The plotter moves the pen in accordance with the coordinates specified as parameters. The status of the pen (raised or lowered) is determined by the PU or PD command issued immediately before this command. The PU, PD, and PA commands can be combined by delimiting them with semicolons.

If the parameters are omitted, the pen does not move and its status remains the same.

(Example)

IN:

PA 2000, 1500, PD; PR-2000, 0, 2000, 2000, 0, -2000;
PU 500, 0; PD2000, 0, -2000, 2000, 0, -2000; PU;

Relative-coordinate movements

FT

Fill Type command: Shading selection command (filling and hatching)

Command symbol:	FT
Function:	Shading selection command
Input format:	FT(n , d , θ)); FT;
Statement example:	PRINT #1, "FT4, 100, 45;"
Parameter definition:	n : Types of shading d : Line spacing of hatching (or cross-hatching) θ : Angle of hatching (or cross-hatching)
Parameter range:	$1 \leq n \leq 4$ $0 \leq d \leq 32767$ (MP4100, 4200) $0 \leq d \leq 2^{23}-1$ (MP4300, 4400) $-45 \leq \theta \leq 45$ (MP4100, 4200) $-2^{23} \leq \theta \leq 2^{23}-1$ (MP4300, 4400)
Related commands:	LT, PT
Description	<p>There are six types of shading:</p> <p>$n = 1$ Solid bidirectional filling $n = 2$ Solid unidirectional filling $n = 3$ Hatching (parallel lines)  $n = 4$ Cross hatching </p>
	If parameter n is omitted, type 1 is selected as the default value.
	Line spacing of hatching is the distance between parallel lines in the fill area.
	Units for spacing are interpreted either as plotter units if scaling is off or as user units if scaling is on. If you omit parameter d and this is the first FT command in your program, spacing is set to 1% of the distance between P1 and P2 as the default value. The spacing parameter is ignored for solid-fill types 1 and 2; in these cases, spacing is determined by the PT command.
	The angle parameter can be specified for any shading type. If you omit the angle parameter in the first FT command in your program, the angle is set to the standard value of 0° (horizontal lines).
	The angle parameter is ignored for solid-fill types 1 and 2 (because it is determined by the PT command); however, this parameter is required as a dummy parameter and cannot be omitted.

PT**PEN THICKNESS command: Shading spacing specification**

Command symbol:

PT

Function:

Specifies the spacing of shading.

Input format:

PT d;
PT;

Statement example:

PRINT #1, "PT0.2;"

Parameter definition:

d: Spacing of shading (mm)

Parameter range:

0.1 ≤ d ≤ 5.0

Related commands:

FT, RA, RR, WG

Description:

This command specifies the spacing of inked lines, in millimeters, to suit the thickness of the pen tip used.

If nothing is set for the spacing of shading, a standard value of 0.3 mm is set.

The PT command is only valid for the pen being used when that command was issued; it is invalidated if executed in the following two cases:

1. When the SP command has been executed or a new pen has been selected from the front panel.
2. When a new PT command is executed.

RA

SHADE RECTANGLE ABSOLUTE command: Absolute-coordinate rectangle shading

Command symbol:

RA

Function:

Defines a rectangle by absolute coordinates and shades the interior of that rectangle.

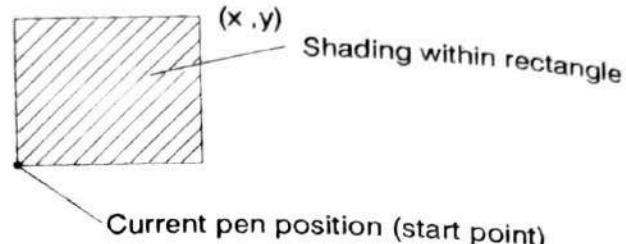
Input format:

RA x, y;

Statement example:

PRINT#1, "RA4000, 3000;"

Parameter definitions:



Parameter range:

 $-32767 \leq x \leq 32767$ (MP4100, 4200) $-2^{23} \leq y \leq 2^{23}-1$ (MP4300, 4400)

Related commands:

EA, ER, RR

Description:

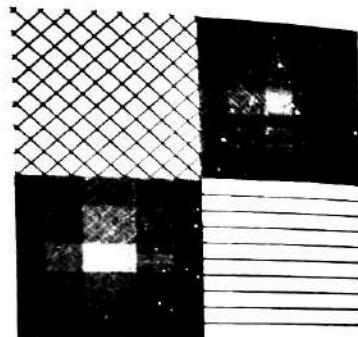
If scaling is off, these parameters are interpreted in plotter units; if scaling is on, they are interpreted in user units.

The X- and Y-coordinates define the opposite side (diagonally opposite corner) of the rectangle, from the current pen position which acts as the start point.

The shading is done with the pen and line type selected at that point. At the completion of the command, the pen returns to the start point and the pen status returns to that before the command was executed.

Example)

```
IN; SP1; PA5000, 4000;  
PT0.3; FT1; RA4000, 3000;  
FT3, 100; RA6000, 3000;  
FT2; RA6000, 5000;  
FT4, 100, 45; RA4000, 5000;  
SPO;
```



EA

EDGE RECTANGLE ABSOLUTE command: Absolute coordinate rectangle plotting

Command symbol:

Function:

Input format:

Statement example:

Parameter definitions:

Parameter range:

Related commands:

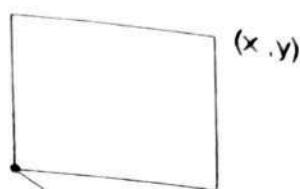
Description:

Example)

EA

Draws a rectangle defined by absolute coordinates
EA x, y;

PRINT #1, "EA4000, 3000;"



$-32767 \leq x \leq 32767$ (MP4100, 4200)

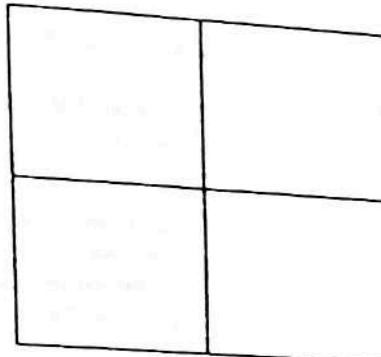
$-2^{23} \leq y \leq 2^{23}-1$ (MP4300, 4400)

RA, ER, RR

If scaling is off, these parameters are interpreted in plotter units; if scaling is on, they are interpreted in user units.

The X- and Y-coordinates define the opposite side (diagonally opposite corner) of the rectangle, from the current pen position which acts as the start point.

IN; SP1, PA5000, 4000;
EA4000, 3000;
SP2; EA6000, 3000;
SP3; EA6000, 5000;
SP4; EA4000, 5000;
SP0;



RR

SHADE RECTANGLE RELATIVE command: Relative coordinate rectangle shading

Command symbol:

RR

Function:

Defines a rectangle by relative coordinates and shades the interior of that rectangle.

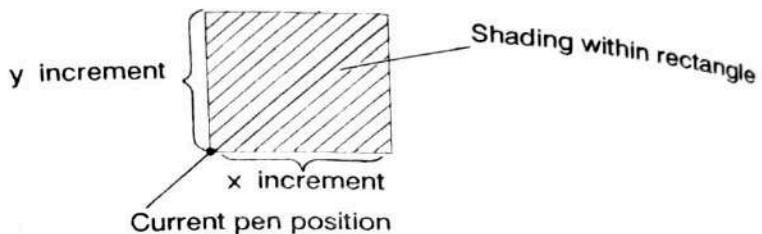
Input format:

RR Δx , Δy ;

Statement example:

PRINT#1, "RR1000, 1000;"

Parameter definition



Parameter range:

 $-32767 \leq \frac{\Delta x}{\Delta y} \leq 32767$ (MP4100, 4200) $-2^{23} \leq \frac{\Delta x}{\Delta y} \leq 2^{23}-1$ (MP4300, 4400)

Related commands:

ER, RA, EA

Description:

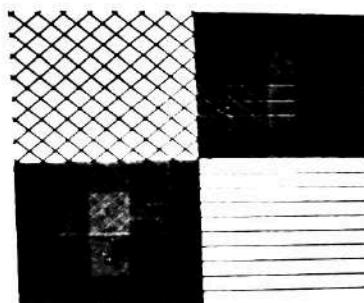
If scaling is off, these parameters are interpreted in plotter units; if scaling is on, they are interpreted in user units.

The x and y increments define the opposite side (diagonally opposite corner) of the rectangle, from the current pen position which acts as the start point.

The shading is done with the pen and line type selected at that point. At the completion of the command, the pen returns to the start point and the pen status returns to that before the command was executed.

Example)

```
IN; SP1, PA5000, 5000;  
PT. 3, FT1; RR1000, 1000;  
PR1000, 0;  
FT3, 100; RR1000, 1000;  
PR0, 1000;  
FT2; RR1000, 1000;  
FT4, 100, 45; RR-1000, 1000;  
SPO,
```



ER

EDGE RECTANGLE RELATIVE command: Relative coordinate rectangle plotting

Command symbol:

ER

Function:

Draws a rectangle defined by relative coordinates.

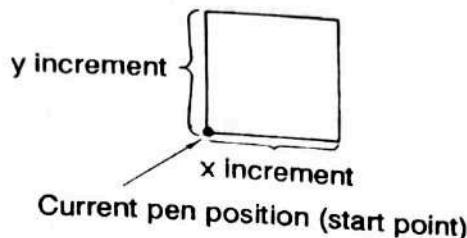
Input format:

ER Δx , Δy ;

Statement example:

PRINT#1, "ER1000, 1000;"

Parameter definition:



Parameter range:

$$-32767 \leq \frac{\Delta x}{\Delta y} \leq 32767 \text{ (MP4100, 4200)}$$

$$-2^{23} \leq \frac{\Delta x}{\Delta y} \leq 2^{23}-1 \quad (\text{MP4300, 4400})$$

Related commands:

RA, EA, RR

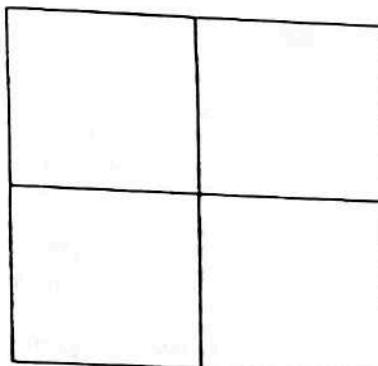
Description:

If scaling is off, these parameters are interpreted in plotter units; if scaling is on, they are interpreted in user units.

The x and y increments define the opposite side (diagonally opposite corner) of the rectangle, from the current pen position which acts as the start point.

Example)

```
IN;SP1;PA5000, 4000;  
ER1000, 1000;  
SP2; ER-1000, -1000;  
SP3; ER-1000, 1000;  
SP4; ER 1000, -1000;  
SP0;
```



WG

SHADE WEDGE command: Segment shading

Command symbol:

WG

Function:

Together with the FT and PT commands, this command defines a segment of a circle and shades its interior.

Input format:

WGr; α , θ (, φ);

Statement example:

PRINT#1, "WG1000, 90, 180, 5,"

Parameter definitions:

r: Radius of segment
 α : Start angle (initial position for drawing of radius)
 θ : Center angle
 φ : Resolution

Parameter ranges:

$-32767 \leq r \leq 32767$ (MP4100, 4200)
 $-2^{23} \leq r \leq 2^{23}-1$ (MP4300, 4400)
 $-360 \leq \alpha \leq 360$
 $-32767 \leq \theta \leq 32767$ (MP4100, 4200)
 $-2^{23} \leq \theta \leq 2^{23}-1$ (MP4300, 4400)
 $1 \leq \varphi \leq 120$

Related commands:

EW, FT, LT, SC

Description:

This command defines a segment of a circle centered on the current pen position, and shades the interior of the segment in the format specified by the LT, FT, and PT commands.

The radius is specified as a real number and its sign determines the position of a reference point.

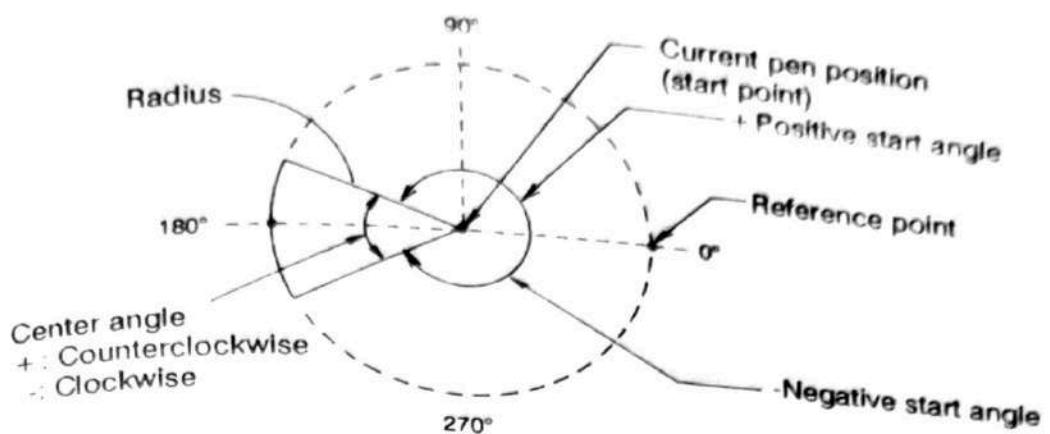
The start angle is specified as an integer: if it is positive, the start point of the segment is in the counterclockwise direction from the reference point; if it is negative, the start point is in the clockwise direction. If the start angle exceeds 360° , 360 is subtracted from it and the remainder is used as the start angle.

The center angle is also an integer: if it is positive, the segment is drawn in the counterclockwise direction from the start point; if it is negative, the segment is drawn in the clockwise direction. If the center angle exceeds 360° , it is set to 360° .

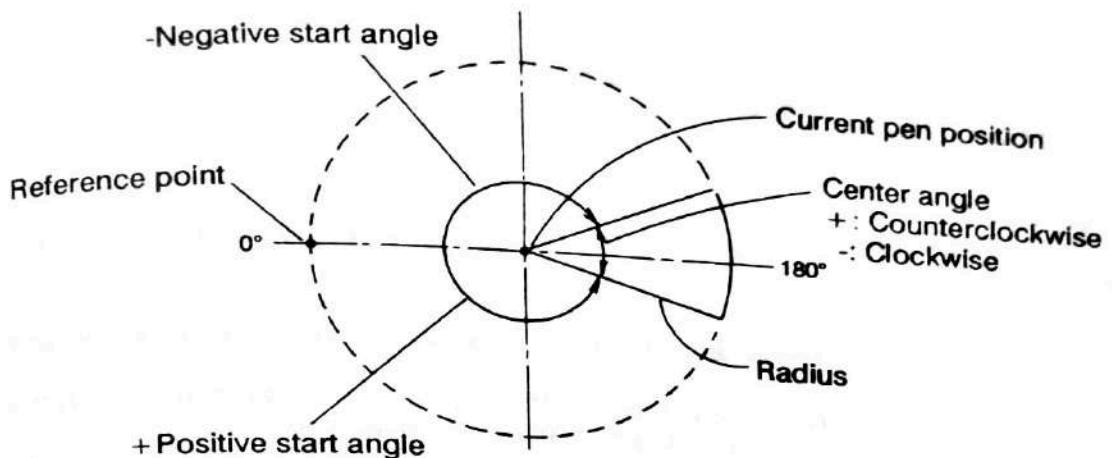
The resolution can be specified as an integer within the range of 1 to 120° , but if a resolution of 4° or less is specified, the plotting is at a resolution of 4° . If no resolution is specified, it is set to 5° .

At the completion of the WG command, the pen status returns to that before the execution of the command.

- When the radius is specified as a positive value -

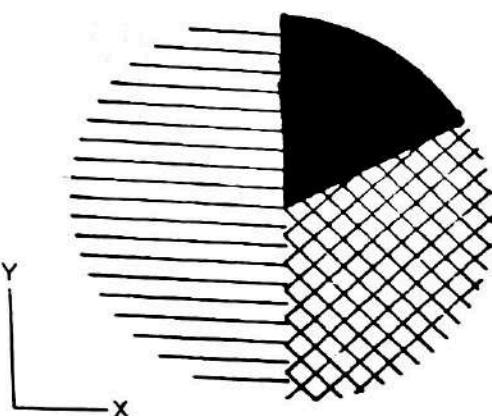


- When the radius is specified as a negative value -



Example)

IN; SP2; FT3, 100;
PA5000, 5000;
WG1000, 90, 180, 5;
SP4; FT4, 100, 45;
WG1000, 270, 120;
SP1; FT1;
WG1000, 30, 60;
SPO;



EW

EDGE WEDGE command: Segment drawing

Command symbol:

EW

Function:

Draws a segment of a circle.

Input format:

EW $r, \alpha, \theta(, \varphi);$

Statement example:

PRINT#1, "EW1000, 90, 60(, 5);"

Parameter definitions

r : Radius of segment
 α : Start angle
 θ : Center angle
 φ : Resolution

Parameter ranges:

$-32767 \leq r \leq 32767$ (MP4100, 4200)
 $-2^{23} \leq r \leq 2^{23}-1$ (MP4300, 4400)
 $-360 \leq \alpha \leq 360$
 $-32767 \leq \theta \leq 32767$ (MP4100, 4200)
 $-2^{23} \leq \theta \leq 2^{23}-1$ (MP4300, 4400)
 $1 \leq \varphi \leq 120$

Related commands:

SC, WG

Description:

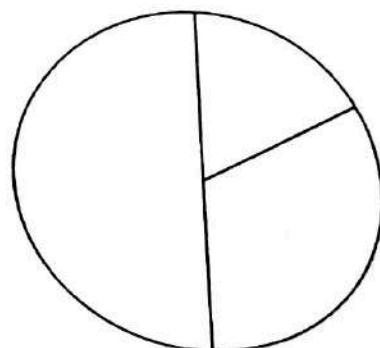
This command draws a segment of a circle centered on the current pen position.

The parameters are the same as those of the WG command.

At the completion of the EW command, the pen status returns to that before the command was executed.

Example)

IN; SP3;
PA5000, 5000;
EW1000, 90, 180, 5;
EW1000, 270, 120;
EW1000, 30, 60;
SP0;



CHARACTER group

CA

Command symbol:

Function:

Input format:

Statement example:

Parameter definition:

Parameter ranges:

Related commands:

Description:

CA

Specifies the alternate character set

CA n;

PRINT#1, "CA1;"

n: Number of alternate character set

0 ≤ n ≤ 101

CS, SS, SA

If an alternate character set has been selected, all the characters written will be of that character set. If the command is given as CA; (parameter omitted), the alternate character set selection is set to 0.

CP

CHARACTER PLOT command: Character-unit movement command

Command symbol:

CP

Function:

Moves the pen to the distance specified by the number of characters.

Input format:

CPn, m;

Statement example:

PRINT#1, "CP5, .35;"

Parameter definitions:

n : Number of characters in the horizontal direction.
m : Number of characters in the vertical direction.

Parameter range:

 $-127.9999 \leq n \leq 127.9999$ (MP4100, 4200) $-2^{23} \leq m \leq 2^{23}-1$ (MP4300, 4400)

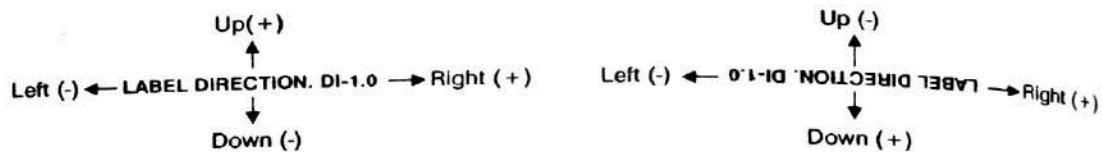
Related commands:

DI, DR, SI, SR

Description:

The CP command can specify a number of characters in the horizontal direction as n and a number of characters in the vertical direction as m.

Select the direction in which the pen moves when writing characters by the signs of the parameters.



The CP; command activates the carriage return and line feed operations.

CS

STANDARD CHARACTER SET command: Standard character set selection command

Command symbol:	CS
Function:	Specifies the standard character set.
Input format:	CSn;
Statement example:	PRINT#1, "CS1,"
Parameter definition:	n: Character set number
Parameter range:	$0 \leq n \leq 101$
Related commands:	CA, SS, SA
Description:	If a standard character set has been selected, all the characters written are of the character set specified by the CS command. The CS; command sets the character set selection to 0. See the ASCII code charts at the end of this manual.

DI

ABSOLUTE DIRECTION command: Absolute character-direction specification command

Command symbol:

DI

Function:

Specifies the orientation of character writing, by absolute coordinates.

Input format:

DI run, rise;

Statement example:

PRINT#1, "D11, 0;"

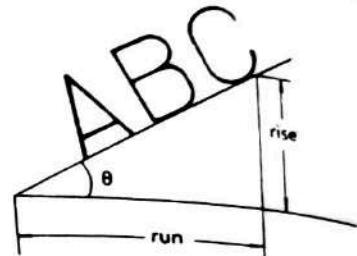
Parameter definition:

The orientation of the characters is given by the relationship rise/run.

Parameter range:

$-127.9999 \leq \frac{\text{run}}{\text{rise}} \leq 127.9999$ (MP4100, 4200)

$-2^{23} \leq \frac{\text{run}}{\text{rise}} \leq 2^{23}-1$ (MP4300, 4400)



Related commands:

DR, LB

Description:

The DI command specifies the orientation of characters and character strings.

If rise is omitted, the plotter handles it as rise = 0 so that the command becomes the same as the D1; command; that is, the initial setting of DI 1, 0.

DR

RELATIVE DIRECTION command Relative character direction specification command

Command symbol:

Function:

Input format:

Statement example:

Parameter definitions:

Parameter range:

Related commands:

Description:

DR

Specifies the orientation of character writing, by relative coordinates.

DR run, rise;

PRINT#1, "DR2, 1;"

run: Percentage of $|P2x - P1x|$

rise: Percentage of $|P2y - P1y|$

$-127.9999 \leq \frac{\text{run}}{\text{rise}} \leq 127.9999$ (MP4100, 4200)

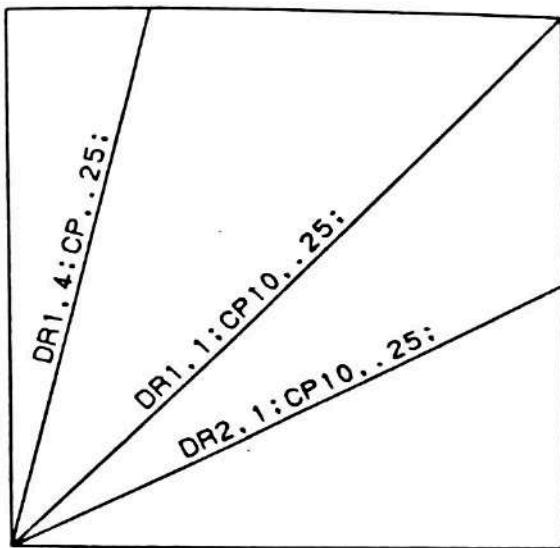
$-2^{23} \leq \frac{\text{run}}{\text{rise}} \leq 2^{23}-1$ (MP4300, 4400)

DI, LB

The DR command specifies the orientation of character writing, with respect to the scaling points P1 and P2.

Specify the run parameter as a percentage of $|P2x - P1x|$ and rise as a percentage of $|P2y - P1y|$.

Other factors are the same as those of the DI command.



DT

DEFINE TERMINATOR command: Character string terminator specification command

Command symbol:

DT

Function:

Specifies the terminator for character strings to be written.

Input format:

DTt;

Statement example:

PRINT#1, "DT; CHR\$(3); ";"

Parameter definition:

t: An ASCII control character that can be specified as a parameter.

Parameter range:

t: 01H to 7FH (01H to 20H are not printed.)

Related commands:

LB

Description:

The DT command specifies the character to be used as label terminator. The ASCII character specified as the parameter becomes the label terminator.

If an ASCII control character is used as label terminator, it is not printed, but its usual functions are performed. If an ASCII character is used, it is printed at the end of the character string.

In the initial setting, the label terminator is the ASCII code ETX (CHR\$(3)). NULL, ES, LF characters and ";" cannot be used as the label terminator. If DT; is specified, the label terminator is set to ETX (CHR\$(3)), the default condition.

DV

VERTICAL LABEL DIRECTION command: Command specifying plotting direction of character strings

Command symbol:
DV

Function:
Plotting

Input format:
DVn;

Statement example:
PRINT#1, "DV1;"

Parameter range:
n = 0 or 1

Related commands:
DI, DR, LO

Description:
The DV1; command specifies the plotting direction of character strings to the vertical direction. The DV0; or DV; command returns the plotting direction of character strings to the horizontal direction (which is the initial setting).

LB

LABEL command: Character string writing command

Command symbol:

LB

Function:

Writes a character string in the character set selected at that time.

Input format:

LB c₁ c_n t

Statement example:

PRINT#1, "LBABCDE"; CHR\$(3)

Parameter definitions:

c₁.....c_n : Character string
t : ASCII character code specified by the parameter of the DT command.

Parameter range:

c : 01H to 7FH

Related commands:

CA, CP, CS, SA, SS, DT, DI, DR, DV, LO, SI, SR, SL

Description:

The LB command plots the character string specified by c₁.....c_n.

Characters are regarded as belonging to a single character string as far as the terminator specified by the DT command. If a label terminator is received, a new line is started.

The terminator is written as well if it is a printable character. Writing takes place regardless of PU and PD commands.

This command is affected by the SI, SR, DI, and DR commands.

The initial value for the label terminator is ETX in ASCII code (CHR\$(3)).

LO LABEL ORIGIN command: Character string start point specification command

Command symbol:
Function:

LO

Specifies the position at which characters are written, relative to the current pen position.

Input format:

LOn;
LO;

Statement example:
Parameter definition:

PRINT#1, "LO5;"

Parameter ranges:
Related commands:

n: Specifies the start point of the character string.

1 ≤ n ≤ 9

LB

Description:

This command specifies the starting position for writing characters, relative to the current pen position.
It is also enables a character to be plotted based on the current pen position as the center (using the LO5; command).
The figure below shows the relationship between the parameter value and the change in the character position in case the starting point is specified in the range of 1 to 9. Note that the black dot indicates the position of the pen immediately before plotting was started.

- When DV0; is specified.

L03	L06	L09
L02	L05	L08
L01	L04	L07

- When DV1; is specified.

L	L	L	L	L	L	L
0	0	0	0	0	0	0
1	2	3	4	5	6	7

In case the parameter is omitted, the starting point will be identical to the L01; position.

SA

SELECT ALTERNATE SET command: Alternate character set specification command

Command symbol: SA
Function: Enables character writing with the alternate character set.
Input format: SA;
Statement example: PRINT#1, "SA;"
Related commands: CA, CS, SS

Description: The SA command specifies that the alternate character set specified by the CA command is used for the writing of characters.

It is possible to select the use of the standard character set within the LB command, as follows:

To specify the standard character set:

Shift-in (CHR\$(15))

To specify the alternate character set:
Shift-out (CHR\$(14))

Example)

PRINT#1,"LB";CHR\$(14);character string;(t)
(t) is a terminator

SI ABSOLUTE CHARACTER SIZE command: Absolute character size specification command

Command symbol:
SI

Specifies character size as absolute values.

Function:

SIw, h;

Input format:

PRINT#1, "SI .55, .75;"

Statement example:

w: Character width
h: Character height

Parameter definitions:

$-127.9999 \leq w \leq +127.9999 (\neq 0)$ (MP4100, 4200)

Parameter definitions:

$-2^{23} \leq h \leq 2^{23}-1 (\neq 0)$ (MP4300, 4400)

Related commands:

SR, DI, DR

Description:

The SI command specifies the character size in centimeters.

Specify the parameters as positive or negative real numbers.

The characters are written as shown below, depending on the signs of the parameters.

SI 0.5.0.75:LBABC

ABC

SI -0.5.0.75:LBABC

ABC

SI 0.5.-0.75:LBABC

ABC

SI -0.5.-0.75:LBABC

ABC

* When bit 2 of the DIP switches on the control panel is set to OFF.

The SI; command specifies a character width of 0.285cm and a character height of 0.375cm.

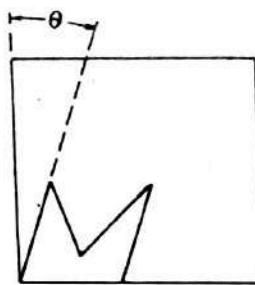
* When bit 2 of the DIP switches on the control panel is set to ON.
The SI; command specifies a character width of 0.75 % of $|P2x-P1x|$ and a character height of 1.5% of $|P2y-P1y|$.

SL

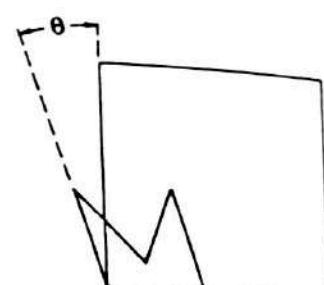
CHARACTER SLANT command: Character string inclination specification command

Command symbol:	SL
Function:	Specifies the inclination of characters.
Input format:	SL tan θ ;
Statement example:	PRINT#1, "SL1;"
Parameter definition:	$\tan \theta$: Tangent of angle from vertical
Parameter range:	$0.05 \leq \tan \theta \leq 2$:For standard-size characters $0.05 \leq \tan \theta \leq 3.5$:For large-size characters
Related commands:	DI, DR, LB
Description:	The SL command specifies the inclination of characters.

The parameter specifies the tangent of the angle from the vertical, as shown in the following figure.



When parameter is positive



When parameter is negative

The effective parameter range is between 0.5 and ± 2 for standard-size characters, and up to 3.5 for large-size ones.

The SL; command writes characters without any inclination.

S11.1:SL1: PLOTTER

S11.1:SL-1: PLOTTER

SR

RELATIVE CHARACTER SIZE command: Relative character size specification command

Command symbol:

SR

Function:

Specifies character size as relative values.

Input format:

SRw,h;

Statement example:

PRINT#1, "SR .55, .75,"

Parameter definitions:

w : Character width |(P2x-P1x)|
h : Character height |(P2y-P1y)|

Parameter range:

 $-127.9999 \leq \frac{w}{h} \leq +127.9999 (\neq 0)$ (MP4100, 4200) $-2^{23} \leq \frac{w}{h} \leq 2^{23}-1 (\neq 0)$ (MP4300, 4400)

Related commands:

SI, DI, DR

Description:

The SR command specifies the size of characters with respect to the scaling points P1 and P2.

Specify the character width as a percentage of |P2x-P1x|, and the character height as a percentage of |P2y-P1y|.

The signs of the parameters are handled in the same way as in the SI command.

When bit 2 of the DIP switches on the control panel is set to ON.

The SR; command specifies a character width of 0.75% of |P2x-P1x| and a character height of 1.5% of |P2y-P1y|.

IPO,0,5000,5000;SR10,10; PLOTTER

IPO,0,10000,10000;SR10,10; PLOTTER

SS

SELECT STANDARD SET command: Standard character set specification command

Command Symbol: SS

Function: Enables the writing of characters in the standard character set

Input format: SS;

Statement example: PRINT#1, "SS;"

Related commands: CA, CS

Description: The SS command specifies the use of the standard character set specified by the CS command for the writing of characters. The selection of the standard character set can also be specified in the LB command as follows:

To specify the standard character set:
Shift-in (CHR\$(15))

To specify the alternate character set:
Shift-out (CHR\$(14))

Example)

PRINT#1,"LB"; CHR\$(14)); character string;(t)
(t) is a terminator

JC

USER DEFINED CHARACTER command: User-defined character command

command symbol

function:

input format

statement example:

parameter definitions:

parameter ranges:

Related commands:

Description:

UC

Writers any desired character.

UC (i,) x₁, y₁, (i,) x₂, y₂ (i,) x_n, y_n;**PRINT#1, "UC8, 14, 99;"**

i: Pen control value specifying the raising or lowering of the pen
 The pen is raised at the beginning and end of the UC command
 The pen status specified by the PU or PD commands does not affect this parameter.

x,y: Specify the magnitudes of pen movements in the horizontal and vertical directions, using character grids as units. The pen moves to the right when a positive value is specified and to the left when a negative one is specified.

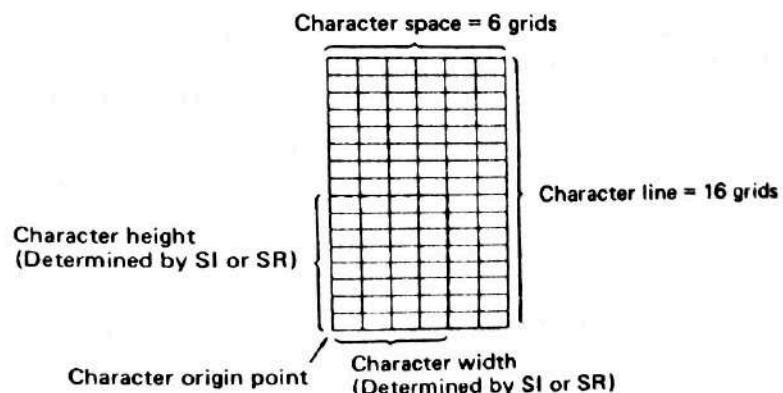
 $-2^{15}+1 \leq i \leq -99 \rightarrow \text{pen up (MP4100, 4200)}$
 $99 \leq i \leq 2^{15}-1 \rightarrow \text{pen down}$
 $-2^{23} \leq i \leq -99 \rightarrow \text{pen up (MP4300, 4400)}$
 $99 \leq i \leq 2^{23}-1 \rightarrow \text{pen down}$
 $-98 \leq y \leq 98$
SI, SR

The UC command draws any user-defined character, in accordance with the specifications of the parameters with respect to the current pen position.

Pen control specified by the UC command is effective only during that command; it has no effect on other commands.

The pen status used immediately before the activation of the UC command is ignored during the command, but is maintained after the completion of the command.

After the execution of the UC command, the pen returns to the character origin as shown below.

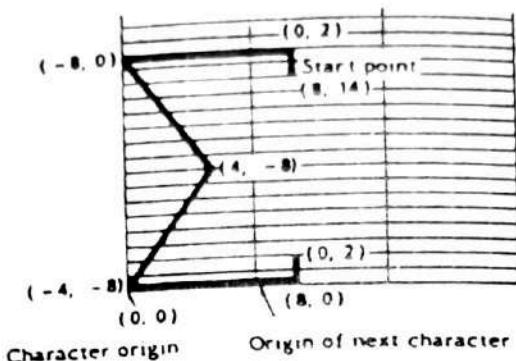


The character grids depend on the character set selected, as shown in the following figure.

As shown above, a character defined by the UC command is not restricted to the normal area occupied by one character. If the defined character occupies more space than a normal character, the FA, PR, or CP command must be used to move the pen to the outside of the defined character; if you fail to do so, the writing of the next character will overlap that of the defined character.

Example)

PRINT#1, "UC8, 14, 99, 0, 2, -8, 0, 4, -8, -4, -8, 8, 0, 0, 2;"



LINE TYPE GROUP

LT

LINE TYPE command: Broken-line mode selection command

Command symbol:

LT

Function:

Specifies solid line and 7 types of broken line.

Input format:

LTn (, ℓ);
LT;

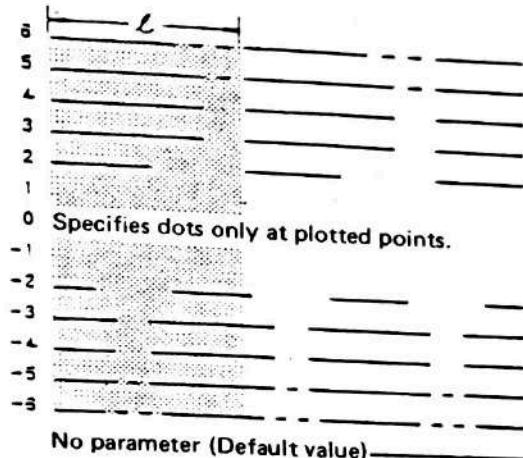
Statement example:

PRINT#1, "LT1, 20;"

Parameter definitions:

n: Line type pattern number

ℓ: Pattern pitch



Parameter ranges:

 $-6 \leq n \leq 6$ Broken lines $0 \leq \ell \leq 127.999$ (MP4100, 4200) $0 \leq \ell \leq 2^{23}-1$ (MP4300, 4400)

LT; Solid line

Related commands:

AA, AR, CI, FT, PA, PD, PR, WG

Description:

Use the LT command to specify a line type (pattern) by its pattern number and pattern pitch together with the AA, AR, CI, PA, PR, RA, RR, WG and FT commands.

The pattern pitch parameter specifies the length of the pattern as a percentage of the diagonal distance between the scaling points P1 and P2.

If no pattern pitch is specified, 4% is set.

Because a circle or arc is plotted as a sequence of short straight lines, do not specify a negative value for the line type pattern number when plotting a circle or arc with such commands as AA, AR, CI, etc.

SM

SYMBOL MODE command: Symbol specification command

Command symbol:

SM

Function:

Plots a character as a plot point.

Input format:

SMc;

Statement example:

PRINT #1, "SMX;"

Parameter definition:

c: Character,symbol

Parameter range:

c: 01H to 7FH (01H to 20H are not printed.)

Related commands:

PA, PD, PR, PU, SI, SR, SL, DI, DR

Description:

Use the SM command together with the PA or PR command to write a character centered on the end point of a straight line segment.

The parameter is limited to one printable character.

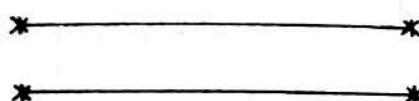
The character printed will be of the character set selected when the SM command was executed, regardless of any subsequent change of character set.

The SI, SR, SL, DI, and DR commands affect the character and symbol printed.

The SM; command releases this mode.

Example)

```
SM* ; PU ; PA3000,3000 ; PD ; PR3000,0 ;
```



SP | PEN SELECT command: Pen selection command

Command symbol:

SP

Used by programs to select pens.

Function:

SPn;
SP;

Input formats:

PRINT#1, "SP1;"

Statement example:

n: Number of pen stocker position

Parameter definition:

$0 \leq n \leq 8$

Parameter range:

If this command is executed when a pen has been exchanged, the pen specified by the parameter n is selected.

Description:

Pen 1 is selected when the plotter is initialized.

If this command is not issued, the plotter will always use Pen 1 for plotting.

$n = 0$ returns the currently-used pen to the pen stocker.

If the position from which this pen was picked up is now occupied, the pen is returned to the empty position with the lowest number in the pen stocker.

When plotting is completed, or is suspended for more than 8 seconds, the pen carriage automatically returns the pen to the stocker to prevent the pen drying up (this is called the Auto Pen Stock operation), then goes back to where it was before it returned the pen.

When the next command is received the pen carriage picks up the pen it had returned to the stocker, unless an exchange of pen is specified by the SP command, and restarts the plotting from the coordinates of the pen before it was returned.

- * When the plotter is initialized, the pen carriage waits, without a pen, at the HOME position until a plotting command is given. When a plotting command is issued, it goes to picks up a pen from the stocker.
- * If an SP command with parameter $n = 0$ is received when the pen has been returned to the pen stocker by the Auto Pen Stock operation, the pen number stored in the plotter's memory will be cleared (without any movement).
- * If plotting commands are subsequently issued, the plotter performs the specified actions without holding a pen, unless a pen exchange command is excuted.

VS

VELOCITY SELECT command: Speed specification command

Command symbol: VS

Function: Specifies the plotting speed.

Input format: VSv (, n);
VS;

Statement example: PRINT#1, "VS10"

Parameter definitions:
v: Pen speed.(cm/sec)
n: Pen specification (number of pen stocker position)Parameter ranges:
 $1 \leq v \leq 50$ (MP4100, 4200)
 $1 \leq v \leq 64$ (MP4300, 4400)
 $1 \leq n \leq 8$ Description:
The pen speed specified by the VS command applies only when the pen is lowered. When the pen is raised, it will always move at the maximum speed of the plotter.

If a pen is specified by the parameter, the pen speed applies only to that pen. If no pen is specified, the speed applies to all pens.

The VS; command returns the pen speed to the initial setting value.
When a parameter is outside the specified range, the plotter ignores this command.

DIGITIZE GROUP

DC

DIGITIZE CLEAR command: Digitization clear command

Command symbol:

DC

Function:

Terminates digitize mode.

Input format:

DC;

Statement example:

PRINT#1, "DC;"

Related command:

DP

Description:

Execution of the DC command enables the "DIGITIZE MODE" display to be cleared and the digitize mode to be terminated. When digitize mode is terminated, the coordinate values will not be input (digitized) when the ENTER key is pressed.

DP

DIGITIZE POINT command. Digitization command

Command symbol:

DP

Function:

Reads out the coordinates of a point to be digitized.

Input format:

DP;

Statement example:

PRINT#1, "DP;"

Description:

Use the DP command to digitize a point on the plotter. When it receives the DP command, the display indicates 'DIGITIZE MODE' and enables digitization.

When the ENTER key is pressed, the current pen position (x-and y-coordinates) and pen status are stored in the plotter.

The display indication goes off and bit 2 of the status byte is set at the same time, enabling the output of data on the digitized point.

OD

OUTPUT DIGITIZED POINT AND PEN STATUS command: Digitized point output command

Command symbol:
OD

OD

Enables the output of read-in coordinates.

Function:
OD;

OD;

Input format:
PRINT#1, "OD;"
Statement example:

PRINT#1, "OD;"

x, y, p [TERM]

Output format:
DP, DC, OS

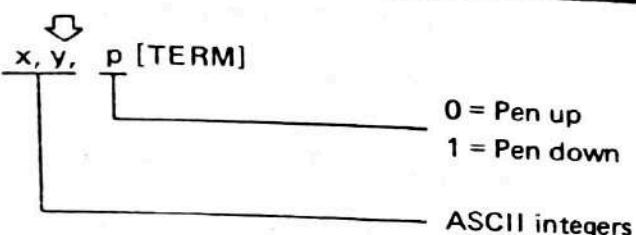
DP, DC, OS

Related commands:
Description:

The OD command makes it possible to output the x- and y-coordinates and pen status of the point digitized immediately before the receipt of the command. (When the ENTER key was pressed.)

When requested by the computer, the plotter outputs the position and status of the pen as ASCII integers. The format is as follows:

x-coordinate, y-coordinate, pen status (terminator)



When it receives the OD command, the plotter clears bit 2 of the status byte and the display indication goes off.

AXIS GROUP

TL

TICK LENGTH command: Axis graduation length specification command

Command symbol: **TL**

Function: Specifies the lengths of graduations (ticks) on coordinate axes

Input format: **TL tp (, tm);**Statement example: **PRINT#1, "TL100,"**

Parameter definitions: tp: Length of XT or YT in the positive direction:
Length of XT in the positive direction
 $= (P2y - P1y) \times tp \%$
Length of YT in the positive direction
 $= (P2x - P1x) \times tp \%$

tm: Length of XT or YT in the negative direction
Length of XT in the negative direction
 $= (P2y - P1y) \times tm \%$
Length of YT in the negative direction
 $= (P2x - P1x) \times tm \%$

If tm is omitted, tm = 0 is assumed.

If both parameters (including tp) are omitted, they are set to their initial value (tp = tm = 0.5).

Parameter range: $-127.999 \leq \frac{tp}{tm} \leq 127.999$ (MP4100, 4200)
 $-2^{23} \leq \frac{tp}{tm} \leq 2^{23}-1$ (MP4300, 4400)

Related commands: **XT, YT, SC**

Description:

The TL command specifies the length of ticks to be plotted by the XT, YT and other commands.

The lengths of ticks are taken as percentages of the horizontal and vertical distances between the scaling points P1 and P2.

The parameter for the tick length in the positive direction specifies ticks above the X-axis and to the right of the Y-axis. The parameter for the tick length in the negative direction specify ticks below the X-axis and to the left of the Y-axis.

Each parameter specifies the tick length as a percentage of $|P2y - P1y|$ when this command is used together with the XT command, or as a percentage of $|P2x - P1x|$ when used together with the YT command.

The TL; command returns the parameters to their initial value of 0.5%.

XT | X TICK command: Axis graduation plotting command

YT | Y TICK command: Axis graduation plotting command

Command symbol:

XT
YT

Function:

Input format:

XT;
YT;

Statement example:

PRINT#1, "XT;"
PRINT#1, "YT;"

Related commands:

TL

Description:

Use the XT or YT command to plot a tick on the X-or Y-axis at the current pen position.

The length of the tick drawn is the integer value given by the TL command issued before the XT or YT command. If no TL command is issued, a tick length of 0.5% of $|P2x - P1x|$ or $|P2y - P1y|$ is used.

This commands are not affected by the PD, PU, LT, and SC commands.

Example)

PU; PA8000, 5000; PD; XT; PR2000, 0; XT;



SET-UP GROUP

IP

INPUT P1 and P2 command: P1, P2 setting command

Command symbol:

IP

Function:

Sets the scaling points.

Input format:

IP P1x, P1y, P2x, P2y;

Statement example:

PRINT #1, "IP3000, 2000, 8000, 7000;"

Parameter definitions:

P1x,P1y: Set the scaling point P1.

P2x,P2y: Set the scaling point P2.

Parameter range:

 $-2^{15}+1 \leq$ each parameter $\leq 2^{15}-1$ (MP4100, 4200) $-2^{23} \leq$ each parameter $\leq 2^{23}-1$ (MP4300, 4400)

Related commands:

SC, RO

Description:

The IP command sets scaling points for a program.

Specify the coordinates for P1 and P2 in plotter units. If the coordinates for P2 are not specified by this command, P2 is changed by the same increments as P1, so that the horizontal and vertical distances between P1 and P2 remain the same.

When a valid IP command is received, bit 1 of the plotter's status byte is set.

The IP; command returns each coordinate to its initial setting as determined by the paper size.

For more information on the initial settings, see section 3-3, "Plotting area."

IW

INPUT WINDOW command: Plotting area setting command

Command symbol:

IW

Function:

Limits the plotting to within a freely-specifiable area.

Input format:

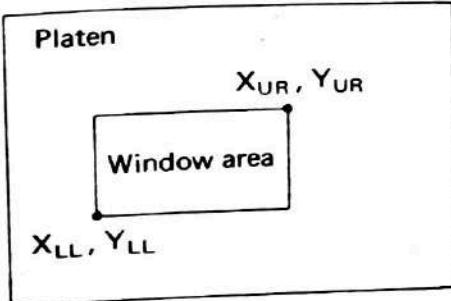
IW X_{LL} , Y_{LL} , X_{UR} , Y_{UR} ;

Statement example:

PRINT#1, "IW4600, 2000, 7600, 7000,"

Parameter definitions:

X_{LL}, Y_{LL} : Set the window area by the lower left end of the diagonal line.
 X_{UR}, X_{UR} : Set the window area by the upper right end of the diagonal line.



Paper size	X_{LL}	Y_{LL}	X_{UR}	Y_{UR}
ANSI B	0	0	16640	10720
ISO A3	0	0	16160	11400
EXPAND	0	0	17280	11880

Related commands:

OW

Description:

Use the IW command to limit the area in which the pen is moved by a program. The area set by this command is called a window.

Specify the parameters of this command in plotter units. However, when the plotter is scaling, specify the parameters in user units.

If the plotter receives data specifying coordinates outside the window area, the pen moves from its current position toward the specified point, but stops and rises when it reaches the border of the window. Thereafter, if data specifying a point within the window area is received, the pen restarts plotting from where the line connecting that point and the previous point outside the window area crosses the border of the window area.

The IW; command sets the window to the mechanical limits of the plotter.

OP

OUTPUT P1 and P2 command: P1, P2 output command

Command symbol: OP

Function: Enables the output of the scaling points.

Input format: OP;

Statement example: PRINT #1, "OP;"

Output format P1x, P1y, P2x, P2y [TERM]

Related commands: IP, OS

Description: The execution of the OP command enables the plotter to output the coordinates of the scaling points P1 and P2.

When requested by the computer, the plotter outputs each coordinate in plotter units. The format is as follows:

P1x, P1y, P2x, P2y (terminator)



Example) 200, 200, 15040, 9960 [TERM]

When the output of coordinates is completed, bit 1 of the plotter's status byte is cleared.

SC

SCALE command: Scale setting command

Command symbol:

SC

Function:

Allocates user unit values to the scaling points.

Input formats:

SC Xmin, Ymin, Xmax, Ymax;

Statement example:

PRINT#1, "SC0, 10, 0, 10;"

Parameter definitions:

Xmin, Ymin : Coordinates of P1 in user units
Xmax, Ymax: Coordinates of P2 in user units

Parameter ranges:

 $-2^{15} + 1 \leq \frac{X_{max} - X_{min}}{Y_{max} - Y_{min}} \leq 2^{15} - 1$ (MP4100, 4200) $-2^{23} \leq \frac{X_{max} - X_{min}}{Y_{max} - Y_{min}} \leq 2^{23} - 1$ (MP4300, 4400)

Related command:

IP

Description:

When the plotter is not in scale mode, it employs plotter units which are based on the mechanical resolution of the plotter. In contrast, the SC command assigns user unit values to the scaling points P1 and P2.

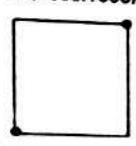
- * After the SC command is executed, the parameters of the AA, AR, CI, EA, ER, EW, FT, RA, RR, WG, PA, and PR commands as well as the response to the OC command will be based on user units.

The relationship between the plotter units (X_m , Y_m) and the user coordinates (X_u , Y_u) conforms to the following equations.

$$X_m = \left(\frac{P_{2x} - P_{1x}}{X_{max} - X_{min}} \right) * (X_u - X_{min}) + P_{1x}$$

$$Y_m = \left(\frac{P_{2y} - P_{1y}}{Y_{max} - Y_{min}} \right) * (Y_u - Y_{min}) + P_{1y}$$

P2(1000,1000)
IPO,0,1000,1000;
SC0,100,0,100;
PU;PA0,0;PD;PR100,0,0,100,-100,0,0-100;



The SC; command cancels the scale mode.

OW

OUTPUT WINDOW command: Plotting range output

Command symbol:

OW

Function:

Enables the output of the coordinates of the lower left and upper right corners of the window area.

Input format:

OW,

Statement example:

PRINT#1, "OW;"

Output format:

X_{LL}, Y_{LL}, X_{UR}, Y_{UR}

Related commands:

IW

Description:

After it receives the OW command, the plotter outputs the range within which the pen moves, in plotter units.

CONFIGURATION & STATUS GROUP

DF

DEFAULT command: Plotter function initialization command

Command symbol:

DF

Sets the plotter to a standard status.

Function:

DF ;

Input format:

PRINT #1, "DF;"

Statement example:

The DF command sets the plotter to a standard (default) status.

Description:

The standard status of the plotter is given in the following table.

Functions	Equivalent command	Status
Alternative character set	CA0;	Set to character set 0.
Standard character set	CS0;	Set to character set 0.
Digitize mode	DC;	DP command is cleared.
Direction of writing	DI1,0;	Horizontal
Label terminator	DT ETX	ETX (ASCII decimal code 3)
Mask values	IM223;	All errors recognized
Window	IW;	Set to the plotter's mechanical limits.
Line type	LT;	Solid line
Scaling	SC;	No scaling
Character slant	SL;	Set to 0°
Symbol mode	SM;	Off
Character size	SR;	
Character width :		Character width: 0.75% of IP2x - P1x1
Character height:		Character height: 1.5% of IP2y - P2y1
Character set	SS;	Standard character set selected.
Graduation (tick) length	TL;	Ticks on X-axis: 0.5% of IP2y - P1y1 Ticks on Y-axis: 0.5% of IP2x - P1x1
Shading type, line spacing, and angle	FT;	Set to type 1 (solid bidirectional filling) Set to 1% of the diagonal distance between P1 and P2. Set to 0° (horizontal) Set to 0.3 mm.
Thickness of inked lines	PT;	Horizontal
Vertical label direction	DV;	Current pen position
Label origin	LO1;	Mechanical limits set by the DIP switch.
Paper size	PS;	

The DF command has no effect on the following plotter functions:

1. Position of scaling points P1 and P2
2. The current pen and its position
3. 90°rotation and axis alignment

IM

INPUT MASK command: Mask setting command

Command symbol:

IM

Function:

Sets masks.

Input format:

IMe;

Statement example:

PRINT#1, "IM223;"

Parameter definitions:

e: Sets bit 5 of the plotter's status byte, to set the condition for indicating an error status on the display.

Parameter ranges:

See the mask values in the table below.

Related commands:

OE, OS

Description:

The IM command specifies the condition for sending HP-GL errors to the computer.

The e mask value is a total of the bit value combinations given in the table below.

If the parameters are omitted, the mask value is set to 223.

e mask

e mask value	Error number	Meaning of error
1	1	An unrecognizable command was issued.
2	2	Invalid number of parameters
4	3	An unusable parameter was used.
8	4	Not used
16	5	An unusable character set was specified.
32	6	Not used
64	7	Not used
128	8	Not used

IN

INITIALIZE command: Plotter initialization command

Command symbol:

IN

Function:

Initializes the plotter.

Input format:

IN;

Statement example:

PRINT#1, "IN;"

Description:

The IN command returns the plotter to the same status as that when its power has just been turned on. (However, there are some differences, such as the pen position.)

For the initial setting status of the plotter, see the table in section 3-2, "Initial settings."

OA

OUTPUT ACTUAL POSITION AND PEN STATUS command:

Mechanical coordinate
output command

Command symbol: OA

Function: Enables the output of the current position and status of the pen

Input format: OA;

Statement example: PRINT#1, "OA;"

Output format: x, y, p [TERM]

Description: The OA command enables the output of the position and status that the pen had before the execution of the OA command.

If requested by the computer, the plotter transmits the pen position by sending the x-and y-coordinates as ASCII integers and the pen status as 0 or 1. The format is as follows:

x-coordinate, y-coordinate, pen status (terminator)



x, y, p [TERM]



Pen status:

0 = Pen up

1 = Pen down

OC

Command symbol:

Function:

Input format:

Statement example:

Output format:

Description:

OC

Enables the output of the last coordinates sent to the plotter and the pen status.

OC;

PRINT#1, "OC;"

x, y, p [TERM]

The OC command enables the output of the x-and y-coordinates specified by the pen movement command received immediately beforehand, and the pen status.

If scaling is set, user coordinates are output rounded off to integers.

If scaling is set, the output values for the OA and OC commands differ only when the pen has gone offscale.

The current pen position is output for the OA command, while the pen position specified by a command is output for the OC command.

x-coordinate, y-coordinate, pen status (terminator)

x, y, p [TERM]

Pen status:

0 = Pen up

1 = Pen down

OE

OUTPUT ERROR command: Error number output command

Command symbol:

OE

Function:

Enables the output of an error number.

Input format:

OE;

Statement example:

PRINT#1, "OE;"

Output format:

n [TERM]

Description:

The OE command enables the output of a number corresponding to the last error to occur before the receipt of the OE command.

If requested by the computer, the ASCII integer corresponding to the error is output.

error number (terminator)



n [TERM]

The meaning of each error number is as follows:

Error number	Meaning of error
0	No error
1	An unrecognized command was received.
2	Invalid number of parameters
3	An unusable parameter was used.
4	Not used
5	An unusable character set was specified.
6	Not used
7	Not used
8	Not used

When an error number is output to the computer, bit 5 of the status byte of the plotter is cleared and the displayed error indication is cleared.

OF

OUTPUT FACTOR command: FACTOR output command

Command symbol:

OF

Function:

Enables the output of the number of plotter units per millimeter

Input format:

OF;

Statement example:

PRINT#1, "OF;"

Output format:

x, y [TERM]

Description:

If requested by the computer, the plotter always outputs the following:

x-coordinate, y-coordinate (terminator)



40, 40 [TERM]

This example shows that the number of plotter units in a millimeter is 40 for both the x and y directions.

OH

OUTPUT HARD CLIP LIMITS command:

Command reading coordinates of pen movement limits

Command symbol:

OH

Function:

Enables the output of the coordinates of the boundaries of the pen can move within.

Input format:

OH;

Statement example:

PRINT#1, "OH;"

Output format:

X_{LL}, Y_{LL}, X_{UR}, Y_{UR} [TERM]

Description:

The OH command enables the output of the lower left and upper right corners of the mechanical limits of the pen movement area.

If requested by the computer, the plotter outputs data in the following format:

X_{lower left}, Y_{lower left}, X_{upper right},
Y_{upper right (terminator)}

Each coordinate is given in plotter units, with the mechanical limits being determined by the paper size as listed in the table below.

Paper size	X _{LL}	Y _{LL}	X _{UR}	Y _{UR}
ANSI B	0	0	16640	10720
ISO A3	0	0	16160	11400
EXPAND	0	0	17280	11880

OI

OUTPUT IDENTIFICATION command: Model output command

Command symbol:

OI

Function:

Enables the output of the plotter's model number.

Input format:

OI;

Statement example:

PRINT#1, "OI;"

Output format:

7475A (TERM)

Description:

The OI command enables the output of the character string which identifies the model number of the plotter.
If requested by the computer, the plotter outputs the data as follows:

model number (terminator)



7475A (TERM)

If the model of the plotter is identified by the OI command at the beginning of a program, it is possible to branch within the program depending on the type of plotter; this eliminates the need to write different programs for different plotter types. Therefore, this command can be used to write a common program for different types of plotters.

OO

OUTPUT OPTION command: Option output command

Command symbol: OO

Function: Enables the output of the status of options used with the plotter.

Input format: OO;

Statement example: PRINT#1, "OO;"

Description: If requested by the computer, the OO command always outputs the data as follows:

0.	1.	0.	0.	1.	0.	0.	0.	[TERM]
----	----	----	----	----	----	----	----	--------

Indicate plotter has arc and circle instructions

Indicate plotter has pen select capability

OS | OUTPUT STATUS command: Status output command

Command symbol:

OS

Enables the output of the plotter's status byte

Function:

OS;

Input format:

PRINT#1, "OS;"

Statement example:

n [TERM]

Output format:

IM, OD, OE, OP, PD

Related commands:

The OS command converts the plotter's status byte into a decimal value and enables its output.

Description:

The 8-bit status byte within the plotter is converted into an integer from 0 to 255.

If requested by the computer, the plotter outputs data in the following format:

Status byte converted into decimal value (terminator)



n [TERM]

Status byte conversion:

Bit value	Bit position	Meaning of bit
1	0	Pen is down.
2	1	P1 or P2 was changed. (Cleared by OP)
4	2	Digitized point can be output. (Cleared by OD)
8	3	Plotter is initialized. (Cleared by OS)
16	4	Ready to receive next data.
32	5	There is an error. (Cleared by OE)
64	6	(Not used: always 0))
128	7	(Not used: always 0))

RO

ROTATE COORDINATE SYSTEM command: Coordinate system rotation command

Command symbol: RO

Function: Rotates the plotter's coordinate system.

Input format: ROn;

Statement example: PRINT#1, "RO90;"

Parameter range: n : 0 or 90

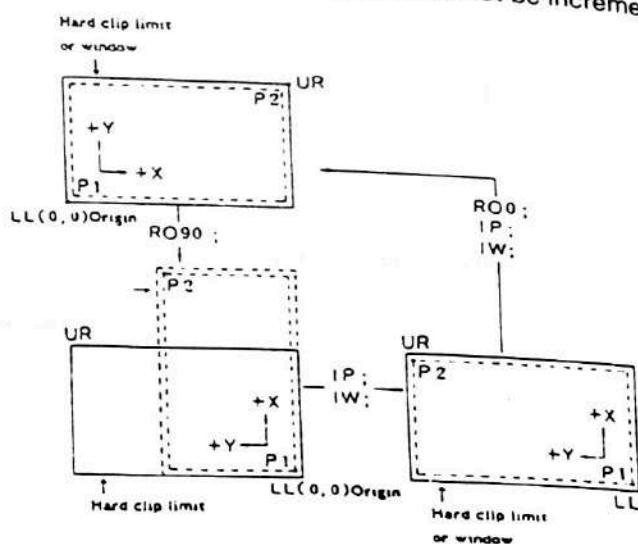
Related commands: IP, IN

Description: The RO command rotates the coordinate system through 90° for a program.

RO 0 or RO; No rotation (same status as that when the plotter's power has been turned on)

RO 90; Rotates the coordinate system through 90°

Rotations of the coordinate system cannot be incremented.



When the coordinate system has been rotated through 90° by the execution of the RO 90; command, the coordinates of P1 and P2 at that time remain as they are. Therefore, it is possible that they will end up outside the plotting limits. In this case, the window will also move out of the plotting limits, since it will also rotate. The parts of the window outside the plotting limits are automatically limited to within the plotting area.

PAPER SIZE command: Paper size specification

Command symbol:
Function:
Input format:
Statement example:
Parameter range:
Description:

PS

Specifies the size of the paper.

PSn;

PRINT#1, "PS100;"

0 ≤ n ≤ 127

This command specifies the size of the paper.

It is possible to switch between two ANSI sizes (A/B) and JIS sizes (A4/A3).

The parameter sets the paper size as follows:

n = 0 to 3: A3/B size specification

n = 4 to 127: A4/A size specification

4. TABLE OF COMMANDS

In the following tables, the below symbols are employed:

[i]: Integer value
 [d]: real number
 [c]: ASCII character

VECTOR group	Command	Data format	Function	Remarks
	AA Absolute-coordinate arc command	AAX,Y, θ (,φ);	Draws an arc centered on the point specified by absolute coordinates	X-coordinate[i], Y-coordinate[i], center angle of arc [d] (, resolution[d])
	AR Relative-coordinate arc command	ARX,Y, (,); θ (, φ);	Draws an arc centered on the point specified by relative coordinates.	X-coordinate[i], Y-coordinate[i], center angle of arc[d] (, resolution[d])
	CI Circle plotting command	Cir(,φ);	Draws a circle of any desired radius.	Radius[i] (, resolution[d])
	CT Resolution parameter type selection command	CTn;	Selects the type of resolution parameter type used in the AA, AR, CI, WG, and EW commands.	
	PA Absolute-coordinate movement command	PAx1,y1 (,..., xn,yn); PA;	Moves the pen to the specified absolute coordinates.	X-coordinate[i], Y-coordinate[i] (,..., X-coordinate[i], Y-coordinate[i])
	PD Pen control command	PD; PDX,Y;	Lowers the pen.	
	PU pen control command	PU; PUx,Y;	Raises the pen.	
	PR Relative-coordinate movement command	PRx1,y1 (,...,xn,yx);	Moves the pen to the specified relative coordinates.	X increment [i], Y increment[i] (,...,X increment, Y increment)
	FT Shading selection command	FT(n(, d(,θ)));	Specifies how shading will be performed.	(type[i] (, line spacing[j] (, angle[j])));

	Command	Data format	Function	Remarks
VECTOR group	PT Shading spacing specification command	PTd;	Specifies the thickness of the inked lines of shading. Spacing of inked lines[d]	
	RA Absolute-coordinate rectangle shading	RA x,y;	Defines a rectangle by absolute coordinates, then shades the interior of that rectangle.	X-coordinate [i], Y coordinate [i]
	EA Absolute-coordinate rectangle plotting	EA x,y;	Draws a rectangle defined by absolute coordinates.	X-coordinate [i], Y coordinate [i]
	RR Relative-coordinate rectangle shading	RRΔx,Δy;	Defines a rectangle by relative coordinates, then shades the interior of that rectangle.	X increment [i], Y increment [i]
	ER Relative-coordinate rectangle plotting	ER Δx, Δy;	Draws a rectangle defined by absolute coordinates.	X increment [i], Y increment [i]
	WG Segment shading	WGr, α, 0(, φ);	Defines a segment of a circle and shades its interior	radius[i], start angle[d], center angle[d] (, resolution[d])
	EW Segment drawing	EWr, α, 0(, θ);	Draws a segment of a circle according to the specified parameters.	radius[i], start angle[d], center angle[d] (, resolution[d])

	Command	Data format	Function	Remarks
CHARACTER group	CA Alternate character set selection command	CAn;	Specifies the alternate character set.	character set number[i]
	CP Character-unit movement command	CPn,m;	Moves the pen the distance specified by the number of characters.	number of characters in horizontal direction[d], number of characters in vertical direction[d]
	CS Standard character set selection command	CSn;	Specifies the standard character set.	character set number[i]
	DI Absolute character-direction specification command	Dirun,rise;	Specifies the orientation of characters, by absolute coordinates.	run[d], rise[d]
	DR Relative character-direction specification command	DRrun,rise;	Specifies the orientation of characters, by relative coordinates.	run[d], rise[d]
	DT Character string terminator specification command	DTt;	Specifies the terminator for character strings to be written.	Character[c] t = Label terminator
	DV Character string plotting direction specification	DV; DVn;	Specifies the plotting direction for character strings.	n: 0 or 1
	LB Character string writing command	LBc1, c2 ... cnt;	Writes a character string using the currently selected character set.	Character string[c] t = Label terminator
	LO Character string start point specification command	LO; LOn;	Specifies the position from which characters are written, relative to the current pen position.	Start position no [i]
	SA Alternate character set specification command	SA;	Enables the writing of characters in the alternate character set.	
	SI Absolute character size specification command	Siw, hi;	Specifies the character size as absolute values.	Character width[d], character height[d]

	Command	Data format	Function	Remarks
CHARACTER group	SL Character string inclination specification command	SLtan 0;	Specifies the inclination of characters.	tanθ[d]
	SR Relative character size specification command	SRw, h;	Specifies the character size as relative values.	Character width[d], character height[d]
	SS Standard character set specification command	SS;	Enables the writing of characters in the standard character set.	The LB command can select character sets as follows: Standard character set: Shift In (1510) Alternate character set: Shift Out (1410)
	UC User-defined character command	UC(l ₁)x1, y1, (l ₁) x ² , y ² , ..., (l _n)x _n , y _n ;	Writes any desired character.	(Pen control value[i],) X increment[d], Y increment[d], (pen control value[i]) ..., ..., X increment[d], Y increment[d]
LINE TYPE group	LT Broken-line mode selection command	LTn(, l);	Specifies a solid line and 7 types of broken lines.	Pattern no.[i](, Pattern length[d])
	SM Symbol specification command	SMc;	Plots a character at a plot point.	Character[c]
	SP Pen selection command	SPn; SP;	Used in programs to retrieves a specified pen.	No. of pen stocker position[i]
	VS Speed specification command	VS; VSV(, n);	Specifies the plotting speed.	Pen speed[i](, No. of pen stocker position[i])
DIGITIZE group	DC Digitization clear command	DC;	Terminates digitize mode.	
	DP Digitization command	DP;	Reads out the coordinates of a point to be digitized.	
	OD Digitized point output command	OD;	Enables the output of the read-in coordinates.	X-coordinate, Y-coordinate, pen status [TERM]

	Command	Data format	Function	Remarks
AXIS group	TL Axis graduation length specification command	TL tp(, tm);	Specifies the lengths of graduations (ticks) on coordinate axes.	Length of XT or YT in positive direction[d], Length of XT or YT in the negative direction[d])
	XT X-axis graduation plotting command	XT;	Plots graduations (ticks) on the X-axis.	
	YT Y-axis graduation plotting command	YT;	Plots graduations (ticks) on the Y-axis.	
SET-UP group	IP P1, P2 setting command	IPP1x, P1y, P2x, P2y;	Sets the scaling points.	P1x[i], P1y[i], P2x[i], P2y[i]
	IW Plotting area setting command	IWXLL, YLL, XUR, YUR	Limits the plotting to within a freely-specifiable area.	X lower right[i], Y lower left[i], X upper left[i], Y upper left[i]
	OP P1, P2 output command	OP;	Enables the output of the scaling points. Enables the output of the coordinates of the window area.	P1x, P1y, P2x, P2y [TERM]
	SC Scale setting command	SC Xmin, Ymin, Xmax, Ymax.,	Allocates user unit values to the scaling points.	Xmin[i], Ymin[i], Xmax[i], Ymax[i];
	OW Plotting range output	OW;	Enables the output of the coordinates of the lower left and upper right corners of the window area.	
CONFIGURATION & STATUS group	DF Plotter function initialization command	DF;	Sets the plotter to a standard status.	
	IM Mask setting command	IMe;	Sets the condition for displaying error statuses	Error mask value[i]
	IN Plotter initialization command	IN;	Initializes the plotter.	

PROGRAM APPLICATION EXAMPLES

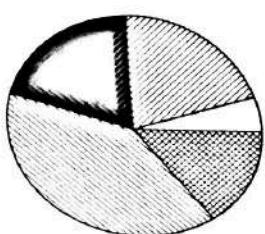
This section describes simple graph-plotting programs using the commands introduced so far. These programs illustrate practical usage methods for the creation of pie charts, line graphs, and bar charts. Refer to them when creating your own programs.

6.1 Pie chart

```

10 Open file
20 PRINT #1, "IP1:000.0.9000.6000:•
30 PRINT #1, "-SC0.1000.0.750:•
40 PRINT #1, "-PU:P4500.500:•
50 READ DAT
60 TH=360/100*DAT
70 PRINT #1, "FT4,10,45:•
80 PRINT #1, "SP1:WG250,90,:-TH:••
90 PRINT #1, "SP2:EW250,90,:-TH:••
100 ST=90-TH
110 READ DAT
120 TH=360/100*DAT
130 PRINT #1, "FT3,10,45:•
140 PRINT #1, "SP1:WG250,:ST:-TH:;•
150 PRINT #1, "SP2:EW250,:ST:-TH:;•
160 ST=ST-TH
170 READ DAT
180 TH=360/100*DAT
190 PRINT #1, "FT2:•
200 PRINT #1, "SP1:WG250,:ST:-TH:••
210 PRINT #1, "SP2:EW250,:ST:-TH:••
220 ST=ST-TH
230 READ DAT
240 TH=360/100*DAT
250 PRINT #1, "FT3,10,135:•
260 PRINT #1, "SP1:WG250,:ST:-TH:••
270 PRINT #1, "SP2:EW250,:ST:-TH:••
280 ST=ST-TH
290 READ DAT
300 TH=360/100*DAT
310 PRINT #1, "EW250,:ST:-TH:••
320 DATA 15, 40, 20, 20, 5

```



6. ASCII CHARACTER CODE TABLES

The plotter has 64 character sets. The following table lists these character sets.

Fixed-Space Vector Font	Variable-Space Arc Font	Fixed-Space Arc Font	Character Set Name
0	10	20	ANSI ASCII
1	11	21	9825 Character Set
2	12	22	French/German
3	13	23	Scandinavian
4	14	24	Spanish/Latin American
5	15	25	Special Symbols
6	16	26	JIS ASCII
7	17	27	Roman Extensions
8	18	28	Katakana
9	19	29	ISO IRV (International Reference Version)
30	40	50	ISO Swedish
31	41	51	ISO Swedish for Names
32	42	52	ISO Norway, Version 1
33	43	53	ISO German
34	44	54	ISO French
35	45	55	ISO United Kingdom
36	46	56	ISO Italian
37	47	57	ISO Spanish
38	48	58	ISO Portuguese
39	49	59	ISO Norway, Version 2
60	70	80	ISO French
99	—	—	Drafting Set

Set 0	Set 1	Set 2	Set 3	Set 4	Set 5	Set 6	Set 7	Set 8	Set 9
! " # \$ % & . () * + - / 0 1 2 3 4 5 6 7 8 9 . . . < = > @ A B C D E F G H I J K L M N O A	! " # \$ % & . () * + - / 0 1 2 3 4 5 6 7 8 9 . . . < = > @ A B C D E F G H I J K L M N O A	! " # \$ % & . () * + - / 0 1 2 3 4 5 6 7 8 9 . . . < = > @ A B C D E F G H I J K L M N O A	! " # \$ % & . () * + - / 0 1 2 3 4 5 6 7 8 9 . . . < = > @ A B C D E F G H I J K L M N O A	! " # \$ % & . () * + - / 0 1 2 3 4 5 6 7 8 9 . . . < = > @ A B C D E F G H I J K L M N O A	! " # \$ % & . () * + - / 0 1 2 3 4 5 6 7 8 9 . . . < = > @ A B C D E F G H I J K L M N O A	! " # \$ % & . () * + - / 0 1 2 3 4 5 6 7 8 9 . . . < = > @ A B C D E F G H I J K L M N O A	! " # \$ % & . () * + - / 0 1 2 3 4 5 6 7 8 9 . . . < = > @ A B C D E F G H I J K L M N O A	! " # \$ % & . () * + - / 0 1 2 3 4 5 6 7 8 9 . . . < = > @ A B C D E F G H I J K L M N O A	! " # \$ % & . () * + - / 0 1 2 3 4 5 6 7 8 9 . . . < = > @ A B C D E F G H I J K L M N O A

(Any character enclosed by boxes functions similarly to a dead key on international keyboards; that is, after that character is printed, the plotter is automatically backspaced by one character space.)

	Set 0	Set 1	Set 2	Set 3	Set 4	Set 5	Set 6	Set 7	Set 8	Set 9
81	Q									Q
82	R	S	T	V						
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(Any character enclosed by boxes functions similarly to a dead key on international keyboards; that is, after that character is printed, the plotter is automatically backspaced by one character space.)

Set 10 Set 11 Set 12 Set 13 Set 14 Set 15 Set 16 Set 17 Set 18 Set 19

(Any character enclosed by boxes functions similarly to a dead key on international keyboards; that is, after that character is printed, the plotter is automatically backspaced by one character space.)

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Set 10 Set 11 Set 12 Set 13 Set 14 Set 15 Set 16 Set 17 Set 18 Set 19

81 Q R S T U V W X Y N [] ^ , - a b c d e f g h i k l m n o p r s t u v w x y z { } ~
82 Q R S T U V W X Y N [] ^ , - a b c d e f g h i k l m n o p r s t u v w x y z { } ~
83 Q R S T U V W X Y N [] ^ , - a b c d e f g h i k l m n o p r s t u v w x y z { } ~
84 Q R S T U V W X Y N [] ^ , - a b c d e f g h i k l m n o p r s t u v w x y z { } ~
85 Q R S T U V W X Y N [] ^ , - a b c d e f g h i k l m n o p r s t u v w x y z { } ~
86 Q R S T U V W X Y N [] ^ , - a b c d e f g h i k l m n o p r s t u v w x y z { } ~
87 Q R S T U V W X Y N [] ^ , - a b c d e f g h i k l m n o p r s t u v w x y z { } ~
88 Q R S T U V W X Y N [] ^ , - a b c d e f g h i k l m n o p r s t u v w x y z { } ~
89 Q R S T U V W X Y N [] ^ , - a b c d e f g h i k l m n o p r s t u v w x y z { } ~
90 Q R S T U V W X Y N [] ^ , - a b c d e f g h i k l m n o p r s t u v w x y z { } ~
91 Q R S T U V W X Y N [] ^ , - a b c d e f g h i k l m n o p r s t u v w x y z { } ~
92 Q R S T U V W X Y N [] ^ , - a b c d e f g h i k l m n o p r s t u v w x y z { } ~
93 Q R S T U V W X Y N [] ^ , - a b c d e f g h i k l m n o p r s t u v w x y z { } ~
94 Q R S T U V W X Y N [] ^ , - a b c d e f g h i k l m n o p r s t u v w x y z { } ~
95 Q R S T U V W X Y N [] ^ , - a b c d e f g h i k l m n o p r s t u v w x y z { } ~
96 Q R S T U V W X Y N [] ^ , - a b c d e f g h i k l m n o p r s t u v w x y z { } ~
97 Q R S T U V W X Y N [] ^ , - a b c d e f g h i k l m n o p r s t u v w x y z { } ~
98 Q R S T U V W X Y N [] ^ , - a b c d e f g h i k l m n o p r s t u v w x y z { } ~
99 Q R S T U V W X Y N [] ^ , - a b c d e f g h i k l m n o p r s t u v w x y z { } ~
100 Q R S T U V W X Y N [] ^ , - a b c d e f g h i k l m n o p r s t u v w x y z { } ~
101 Q R S T U V W X Y N [] ^ , - a b c d e f g h i k l m n o p r s t u v w x y z { } ~
102 Q R S T U V W X Y N [] ^ , - a b c d e f g h i k l m n o p r s t u v w x y z { } ~
103 Q R S T U V W X Y N [] ^ , - a b c d e f g h i k l m n o p r s t u v w x y z { } ~
104 Q R S T U V W X Y N [] ^ , - a b c d e f g h i k l m n o p r s t u v w x y z { } ~
105 Q R S T U V W X Y N [] ^ , - a b c d e f g h i k l m n o p r s t u v w x y z { } ~
106 Q R S T U V W X Y N [] ^ , - a b c d e f g h i k l m n o p r s t u v w x y z { } ~
107 Q R S T U V W X Y N [] ^ , - a b c d e f g h i k l m n o p r s t u v w x y z { } ~
108 Q R S T U V W X Y N [] ^ , - a b c d e f g h i k l m n o p r s t u v w x y z { } ~
109 Q R S T U V W X Y N [] ^ , - a b c d e f g h i k l m n o p r s t u v w x y z { } ~
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114 Q R S T U V W X Y N [] ^ , - a b c d e f g h i k l m n o p r s t u v w x y z { } ~
115 Q R S T U V W X Y N [] ^ , - a b c d e f g h i k l m n o p r s t u v w x y z { } ~
116 Q R S T U V W X Y N [] ^ , - a b c d e f g h i k l m n o p r s t u v w x y z { } ~
117 Q R S T U V W X Y N [] ^ , - a b c d e f g h i k l m n o p r s t u v w x y z { } ~
118 Q R S T U V W X Y N [] ^ , - a b c d e f g h i k l m n o p r s t u v w x y z { } ~
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120 Q R S T U V W X Y N [] ^ , - a b c d e f g h i k l m n o p r s t u v w x y z { } ~
121 Q R S T U V W X Y N [] ^ , - a b c d e f g h i k l m n o p r s t u v w x y z { } ~
122 Q R S T U V W X Y N [] ^ , - a b c d e f g h i k l m n o p r s t u v w x y z { } ~
123 Q R S T U V W X Y N [] ^ , - a b c d e f g h i k l m n o p r s t u v w x y z { } ~
124 Q R S T U V W X Y N [] ^ , - a b c d e f g h i k l m n o p r s t u v w x y z { } ~
125 Q R S T U V W X Y N [] ^ , - a b c d e f g h i k l m n o p r s t u v w x y z { } ~
126 Q R S T U V W X Y N [] ^ , - a b c d e f g h i k l m n o p r s t u v w x y z { } ~

(Any character enclosed by boxes functions similarly to a dead key on international keyboards; that is, after that character is printed, the plotter is automatically backspaced by one character space.)

(Any keyboard character enclosed by boxes functions similarly to a dead key on international keyboards; that is, after that character is printed, the plotter is automatically backspaced by one character space.)

Set 20 Set 21 Set 22 Set 23 Set 24 Set 25 Set 26 Set 27 Set 28 Set 29

(Any character enclosed by boxes functions similarly to a dead key on international keyboards; that is, after that character is printed, the plotter is automatically backspaced by one character space.)

Set 30

Set 20 Set 21 Set 22 Set 23 Set 24 Set 25 Set 26 Set 27 Set 28 Set 29

81 Q R S T U V W X Y Z N C O D E F G H I K L M P
82 Q R S T U V W X Y Z N C O D E F G H I K L M P
83 Q R S T U V W X Y Z N C O D E F G H I K L M P
84 Q R S T U V W X Y Z N C O D E F G H I K L M P
85 Q R S T U V W X Y Z N C O D E F G H I K L M P
86 Q R S T U V W X Y Z N C O D E F G H I K L M P
87 Q R S T U V W X Y Z N C O D E F G H I K L M P
88 Q R S T U V W X Y Z N C O D E F G H I K L M P
89 Q R S T U V W X Y Z N C O D E F G H I K L M P
90 Q R S T U V W X Y Z N C O D E F G H I K L M P
91 Q R S T U V W X Y Z N C O D E F G H I K L M P
92 Q R S T U V W X Y Z N C O D E F G H I K L M P
93 Q R S T U V W X Y Z N C O D E F G H I K L M P
94 Q R S T U V W X Y Z N C O D E F G H I K L M P
95 Q R S T U V W X Y Z N C O D E F G H I K L M P
96 Q R S T U V W X Y Z N C O D E F G H I K L M P
97 Q R S T U V W X Y Z N C O D E F G H I K L M P
98 Q R S T U V W X Y Z N C O D E F G H I K L M P
99 Q R S T U V W X Y Z N C O D E F G H I K L M P
100 Q R S T U V W X Y Z N C O D E F G H I K L M P
101 Q R S T U V W X Y Z N C O D E F G H I K L M P
102 Q R S T U V W X Y Z N C O D E F G H I K L M P
103 Q R S T U V W X Y Z N C O D E F G H I K L M P
104 Q R S T U V W X Y Z N C O D E F G H I K L M P
105 Q R S T U V W X Y Z N C O D E F G H I K L M P
106 Q R S T U V W X Y Z N C O D E F G H I K L M P
107 Q R S T U V W X Y Z N C O D E F G H I K L M P
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110 Q R S T U V W X Y Z N C O D E F G H I K L M P
111 Q R S T U V W X Y Z N C O D E F G H I K L M P
112 Q R S T U V W X Y Z N C O D E F G H I K L M P
113 Q R S T U V W X Y Z N C O D E F G H I K L M P
114 Q R S T U V W X Y Z N C O D E F G H I K L M P
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119 Q R S T U V W X Y Z N C O D E F G H I K L M P
120 Q R S T U V W X Y Z N C O D E F G H I K L M P
121 Q R S T U V W X Y Z N C O D E F G H I K L M P
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123 Q R S T U V W X Y Z N C O D E F G H I K L M P
124 Q R S T U V W X Y Z N C O D E F G H I K L M P
125 Q R S T U V W X Y Z N C O D E F G H I K L M P
126 Q R S T U V W X Y Z N C O D E F G H I K L M P

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(Any character enclosed by boxes functions similarly to a dead key on international keyboards; that is, after that character is printed, the plotter is automatically backspaced by one character space.)

Set 30 Set 31 Set 32 Set 33 Set 34 Set 35 Set 36 Set 37 Set 38 Set 39

33	!"	!"	!"	!"	!"	!"	!"	!"	!"	!"
34	#	=	*\$	*\$	*\$	*\$	*\$	*\$	*\$	*\$
35	x	x	x	x	x	x	x	x	x	x
36	&	&	&	&	&	&	&	&	&	&
37	()	*	*	*	*	*	*	*	*
38	+	+	+	+	+	+	+	+	+	+
39
40	0	1	2	3	4	5	6	7	8	9
41	1	2	3	4	5	6	7	8	9	0
42	2	3	4	5	6	7	8	9	0	1
43	3	4	5	6	7	8	9	0	1	2
44	4	5	6	7	8	9	0	1	2	3
45	5	6	7	8	9	0	1	2	3	4
46	6	7	8	9	0	1	2	3	4	5
47	7	8	9	0	1	2	3	4	5	6
48	8	9	0	1	2	3	4	5	6	7
49	9	0	1	2	3	4	5	6	7	8
50	0	1	2	3	4	5	6	7	8	9
51	1	2	3	4	5	6	7	8	9	0
52	2	3	4	5	6	7	8	9	0	1
53	3	4	5	6	7	8	9	0	1	2
54	4	5	6	7	8	9	0	1	2	3
55	5	6	7	8	9	0	1	2	3	4
56	6	7	8	9	0	1	2	3	4	5
57	7	8	9	0	1	2	3	4	5	6
58	8	9	0	1	2	3	4	5	6	7
59	9	0	1	2	3	4	5	6	7	8
60	0	1	2	3	4	5	6	7	8	9
61	1	2	3	4	5	6	7	8	9	0
62	2	3	4	5	6	7	8	9	0	1
63	3	4	5	6	7	8	9	0	1	2
64	4	5	6	7	8	9	0	1	2	3
65	5	6	7	8	9	0	1	2	3	4
66	6	7	8	9	0	1	2	3	4	5
67	7	8	9	0	1	2	3	4	5	6
68	8	9	0	1	2	3	4	5	6	7
69	9	0	1	2	3	4	5	6	7	8
70	0	1	2	3	4	5	6	7	8	9
71	1	2	3	4	5	6	7	8	9	0
72	2	3	4	5	6	7	8	9	0	1
73	3	4	5	6	7	8	9	0	1	2
74	4	5	6	7	8	9	0	1	2	3
75	5	6	7	8	9	0	1	2	3	4
76	6	7	8	9	0	1	2	3	4	5
77	7	8	9	0	1	2	3	4	5	6
78	8	9	0	1	2	3	4	5	6	7
79	9	0	1	2	3	4	5	6	7	8
80	0	1	2	3	4	5	6	7	8	9

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Set 30	Set 31	Set 32	Set 33	Set 34	Set 35	Set 36	Set 37	Set 38	Set 39
Q	Q R S T U V W X Y Z N A B C D E F G H I J K L M	Q R S T U V W X Y Z N A B C D E F G H I J K L M	Q R S T U V W X Y Z N A B C D E F G H I J K L M	Q R S T U V W X Y Z N A B C D E F G H I J K L M	Q R S T U V W X Y Z N A B C D E F G H I J K L M	Q R S T U V W X Y Z N A B C D E F G H I J K L M	Q R S T U V W X Y Z N A B C D E F G H I J K L M	Q R S T U V W X Y Z N A B C D E F G H I J K L M	Q R S T U V W X Y Z N A B C D E F G H I J K L M
81	82	83	84	85	86	87	88	89	80
90	91	92	93	94	95	96	97	98	99
100	101	102	103	104	105	106	107	108	109
110	111	112	113	114	115	116	117	118	119
120	121	122	123	124	125	126			

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(Any character enclosed by boxes functions similarly to a dead key on international keyboards; that is, after that character is printed, the plotter is automatically backspaced by one character space.)

Set 40 Set 41 Set 42 Set 43 Set 44 Set 45 Set 46 Set 47 Set 48 Set 49
3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

(Any character enclosed by boxes functions similarly to a dead key on international keyboards; that is, after that character is printed, the plotter is automatically backspaced by one character space.)

Set 40 Set 41 Set 42 Set 43 Set 44 Set 45 Set 46 Set 47 Set 48 Set 49

(Any character enclosed by boxes functions similarly to a dead key on international keyboards; that is, after that character is printed, the plotter is automatically backspaced by one character space.)

OLD NAVY

Set 50 Set 51 Set 52 Set 53 Set 54 Set 55 Set 56 Set 57 Set 58 Set 59

— * * * * . () * + - - / 0 1 2 3 4 5 6 7 8 9 . . . V > > A B C D E F G H I J K L M N O P

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... ፳፻፲፭ ዓ.ም. ከፃ፻፲፭ ዓ.ም. ስንጋጌ

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תְּלִימָדָה בְּבֵית-הַמִּזְבֵּחַ

DRAFTS OF THE CONSTITUTION OF THE UNITED STATES

Set

Sect.

בְּרִית מָהֳרָה בְּרִית מָהֳרָה

(Any character enclosed by boxes functions similarly to a dead key on international keyboards; that is, after that character is printed, the plotter is automatically backspaced by one character space.)

Set 50 Set 51 Set 52 Set 53 Set 54 Set 55 Set 56 Set 57 Set 58 Set 59

81	Q R S T U V W X Y Z É Á Í	—	—	—	—	—	—	—	—	—	—	—	—
82	—	—	—	—	—	—	—	—	—	—	—	—	—
83	—	—	—	—	—	—	—	—	—	—	—	—	—
84	—	—	—	—	—	—	—	—	—	—	—	—	—
85	—	—	—	—	—	—	—	—	—	—	—	—	—
86	—	—	—	—	—	—	—	—	—	—	—	—	—
87	—	—	—	—	—	—	—	—	—	—	—	—	—
88	—	—	—	—	—	—	—	—	—	—	—	—	—
89	—	—	—	—	—	—	—	—	—	—	—	—	—
90	—	—	—	—	—	—	—	—	—	—	—	—	—
91	—	—	—	—	—	—	—	—	—	—	—	—	—
92	—	—	—	—	—	—	—	—	—	—	—	—	—
93	—	—	—	—	—	—	—	—	—	—	—	—	—
94	—	—	—	—	—	—	—	—	—	—	—	—	—
95	—	—	—	—	—	—	—	—	—	—	—	—	—
96	—	—	—	—	—	—	—	—	—	—	—	—	—
97	—	—	—	—	—	—	—	—	—	—	—	—	—
98	—	—	—	—	—	—	—	—	—	—	—	—	—
99	—	—	—	—	—	—	—	—	—	—	—	—	—
100	—	—	—	—	—	—	—	—	—	—	—	—	—
101	—	—	—	—	—	—	—	—	—	—	—	—	—
102	—	—	—	—	—	—	—	—	—	—	—	—	—
103	—	—	—	—	—	—	—	—	—	—	—	—	—
104	—	—	—	—	—	—	—	—	—	—	—	—	—
105	—	—	—	—	—	—	—	—	—	—	—	—	—
106	—	—	—	—	—	—	—	—	—	—	—	—	—
107	—	—	—	—	—	—	—	—	—	—	—	—	—
108	—	—	—	—	—	—	—	—	—	—	—	—	—
109	—	—	—	—	—	—	—	—	—	—	—	—	—
110	—	—	—	—	—	—	—	—	—	—	—	—	—
111	—	—	—	—	—	—	—	—	—	—	—	—	—
112	—	—	—	—	—	—	—	—	—	—	—	—	—
113	—	—	—	—	—	—	—	—	—	—	—	—	—
114	—	—	—	—	—	—	—	—	—	—	—	—	—
115	—	—	—	—	—	—	—	—	—	—	—	—	—
116	—	—	—	—	—	—	—	—	—	—	—	—	—
117	—	—	—	—	—	—	—	—	—	—	—	—	—
118	—	—	—	—	—	—	—	—	—	—	—	—	—
119	—	—	—	—	—	—	—	—	—	—	—	—	—
120	—	—	—	—	—	—	—	—	—	—	—	—	—
121	—	—	—	—	—	—	—	—	—	—	—	—	—
122	—	—	—	—	—	—	—	—	—	—	—	—	—
123	—	—	—	—	—	—	—	—	—	—	—	—	—
124	—	—	—	—	—	—	—	—	—	—	—	—	—
125	—	—	—	—	—	—	—	—	—	—	—	—	—
126	—	—	—	—	—	—	—	—	—	—	—	—	—

(Any character enclosed by boxes functions similarly to a dead key on international keyboards; that is, after that character is printed, the plotter is automatically backspaced by one character space.)

Set 60 Set 70 Set 80 Set 99

33	!	!	!
34	"	"	"
35	\$	\$	\$
36	%	%	%
37	*	*	*
38	(((
39)))
40	*	*	*
41	+	+	+
42	.	.	.
43	-	-	-
44	/	/	/
45	0	0	0
46	1	1	1
47	2	2	2
48	3	3	3
49	4	4	4
50	5	5	5
51	6	6	6
52	7	7	7
53	8	8	8
54	9	9	9
55	0	0	0
56
57
58
59	^	=	=
60	>	>	>
61	<	<	<
62	~	~	~
63	è	è	è
64	à	à	à
65	é	é	é
66	í	í	í
67	ó	ó	ó
68	ú	ú	ú
69	ñ	ñ	ñ
70	ñ	ñ	ñ
71	ñ	ñ	ñ
72	ñ	ñ	ñ
73	ñ	ñ	ñ
74	ñ	ñ	ñ
75	ñ	ñ	ñ
76	ñ	ñ	ñ
77	ñ	ñ	ñ
78	ñ	ñ	ñ
79	ñ	ñ	ñ
80	ñ	ñ	ñ



(Any character enclosed by boxes functions similarly to a dead key on international keyboards; that is, after that character is printed, the plotter is automatically backspaced by one character space.)

Set 60 Set 70 Set 80 Set 99

81	G	G	G
82	R	R	R
83	S	S	S
84	T	T	T
85	U	U	U
86	V	V	V
87	W	W	W
88	X	X	X
89	Y	Y	Y
90	Z	Z	Z
91	.	.	.
92	,	,	,
93	‘	‘	‘
94	’	’	’
95	—	—	—
96	—	—	—
97	—	—	—
98	—	—	—
99	—	—	—
100	—	—	—
101	—	—	—
102	—	—	—
103	—	—	—
104	—	—	—
105	—	—	—
106	—	—	—
107	—	—	—
108	—	—	—
109	—	—	—
110	—	—	—
111	—	—	—
112	—	—	—
113	—	—	—
114	—	—	—
115	—	—	—
116	—	—	—
117	—	—	—
118	—	—	—
119	—	—	—
120	—	—	—
121	—	—	—
122	—	—	—
123	—	—	—
124	—	—	—
125	—	—	—
126	—	—	—

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The specifications, etc., in this manual are
subject to change without notice.

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