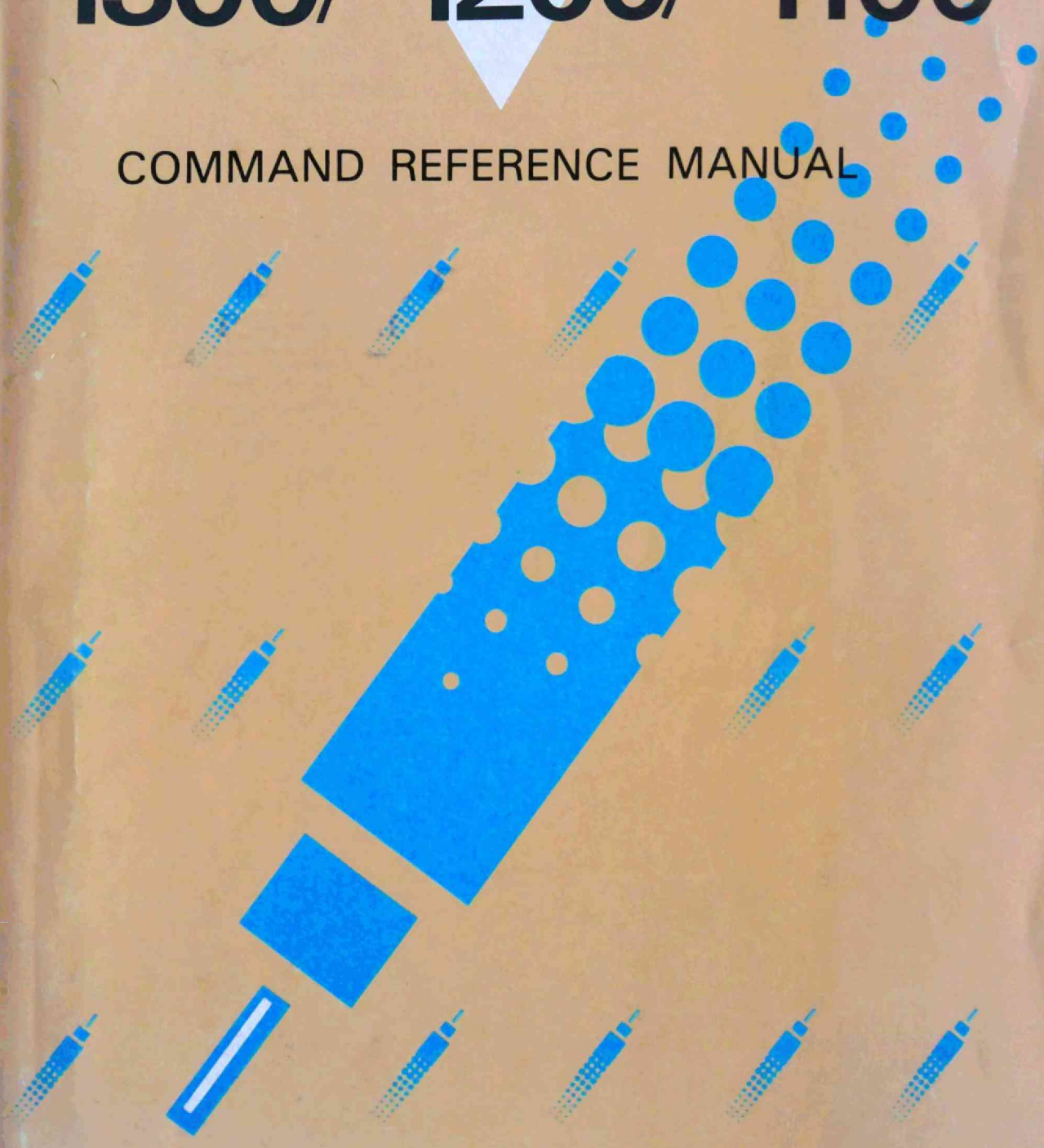
X-Y PLOTTER

DXY -1300/ -1200/ -1100

COMMAND REFERENCE MANUAL



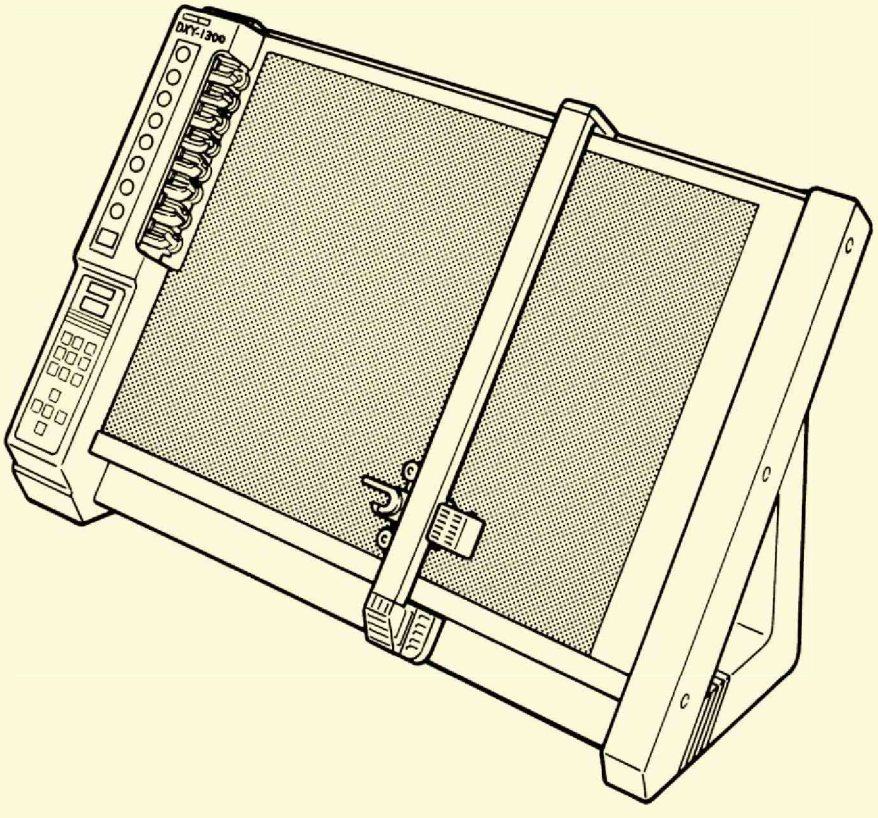
Roland
DIGITAL GROUP

X-Y PLOTTER

DXY

-1300/ -1200/ -1100

COMMAND REFERENCE MANUAL



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CHAPTER 1
SUMMARY OF COMMANDS

1.1 Type of Command

There are two types of command in the DXY-1000 series, and they can be selected by DIP switch.

•DXY-GL commands
These are one-letter character commands which, because of their mutual independence, rarely influence each other and can be easily used to create drawings.
They can be executed by calling RD-GL I commands.

•RD-GL I commands
These are two-letter character commands that have been systematically designed to move the plotter efficiently. This command group possesses a high degree of flexibility because each of its commands has the capacity to make a precise setting of an individual plotter movement.
Please read section "2.2 DXY-GL Command Explanation" in Chapter 2 and section "3.9 RD-GL I Command Explanation" in Chapter 3 for the command functions of these two command systems.

Incidentally, support is provided for those device control commands that are effective only with a serial interface (RS-232C). Device control commands are valid in either the DXY-GL or RD-GL I command systems. Please refer to Chapter 5 "Information about interface" for detailed information on the device control commands.

1.2 Method of Using Commands (BASIC)

This section will cover those features that are common to both command systems (DXY-GL and RD-GL I).

Note:

- The following examples employ the BASIC language. Make any necessary modifications for your particular hardware or version of BASIC.
- All character codes (ASCII codes) use decimal notation.
- CHR$(character code) designates a character code.
- [ESC]CHR$(27) or [ESC] designates a control character.

①When sending commands from the computer to the plotter using the BASIC language, two types of connection may be used:
parallel and serial interface. The following examples show the BASIC format for each of these two connections:

```
LPRINT "PA5000,5000;"        (Parallel connection)

PRINT #1,"PA5000,5000;"      (Parallel, serial connection)
```

In case of a serial connection, it is necessary to match the communications conditions (baud rate, data bit length, stop bit and parity) with the plotter and to open a port to the RS-232C with the "OPEN" command.

②The parameters can be changed with variables. For example,the parameter in this statement

```
10 LPRINT "PA1000,2000;"
```

may be changed with variables as follows:

```
10 X=1000,Y=2000
20 LPRINT "PA";X;",";Y;";"
```

Line 20 can also be written in the following ways:

```
20 LPRINT "PA";X;" ";Y;";      separation with space instead of comma
20 LPRINT "PA";X,Y;";"         separation of variables with comma
20 LPRINT "PA"X,Y";"           omission of semicolon between command an
                               variables
```

Furthermore, character parameters can be written as follows:

```
10 B$="ABCDabcd"
20 LPRINT "LB";B$;CHR$(3)
```

ABCDabcd

Fig. 1-1

```
10 X=1000,Y=2000
20 LPRINT "LB";X;Y;CHR$(3)
```

1000 2000

Fig. 1-2

These formats may differ depending on the particular computer or BASIC language in use. Please consult your computer or BASIC manual as needed.

1.3 Coordinates

In the coordinate system of Fig. 1-3, the longer side of the paper is the X axis the shorter side is the Y axis. A single point on a plane is designated by the values assigned to X and Y, such as (1000,2000).

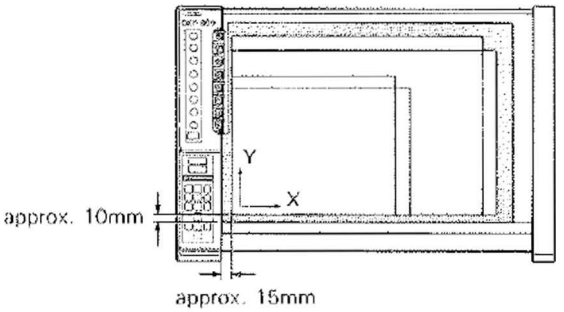
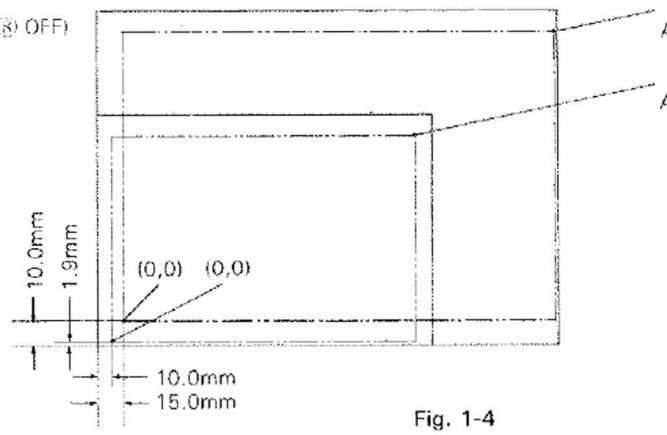


Fig. 1-3

The maximum plotting area (the area where plotting is possible) varies depending on the paper size standard and paper size setting, which are both set with the DIP switches, and the expand mode selection.

When selecting the DXY-GL commanads by DIP switch, the size of the maximum plotting area in plotter coordinate units (0.1mm or 0.025mm) does not change, but the units will be different.

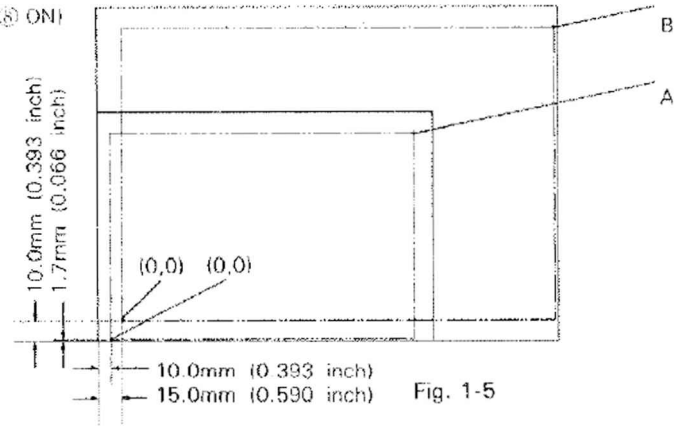
ISO
(DIP SW 1-⑧ OFF)



	0.025mm unit	0.1mm unit
A3	(16158,11040)	(4039,2760)
A4	(11040,7721)	(2760,1930)

Fig. 1-4

ANSI
(DIP SW 1-⑧ ON)



	0.025mm unit	0.1mm unit
B	(16640,10365)	(4160,2591)
A	(10365,7962)	(2591,1990)

Fig. 1-5

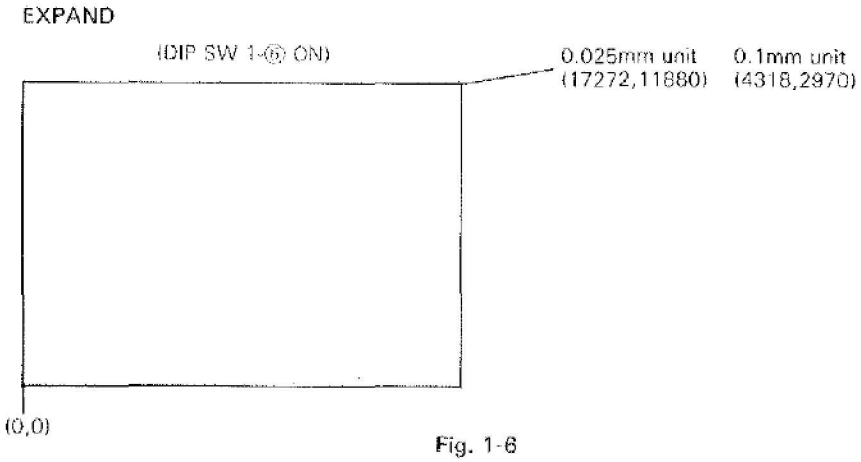


Fig. 1-6

●Absolute Coordinates and Relative Coordinates

There are two methods to specify a coordinate: (1) absolute coordinates, which represent a specified point by its distance from the origin (0,0) and (2) relative coordinates, which represent a specified point by its distance from the current position. For instance, line 20 in Example 1-1 plots a straight line in absolute coordinates.

[EXAMPLE 1-1]

```
10 LPRINT "M100,200;"
20 LPRINT "D400,800;"
```

If relative coordinates are used here, line 20 must be rewritten as follows:

```
20 LPRINT "I300,600;"
```

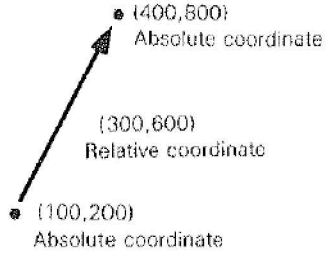


Fig. 1-7

The I command performs straight line plotting in relative coordinates. Since the pen position in line 10 is (100,200), an I command with the relative coordinate (300,600) for the distance from the current position will plot up to the absolute coordinate (400,800).

CHAPTER 2
DXY-GL

2.1 Summary of DXY-GL

DXY-GL commands are mutually independent and rarely influence one another, thus making it easy to do plotting. There are 22 commands.
They can also be used by calling the RD-GL I command.

- The following examples employ the BASIC language. Make any necessary modifications for your particular hardware or version of BASIC.
- All character codes (ASCII codes) use decimal notation.
- CHR$(character code) designates a character code.
- [ESC]CHR$(27) or [ESC] designates a control character.

2.1.1 Format of DXY-GL Commands

The DXY-GL command format comprises the following four elements:

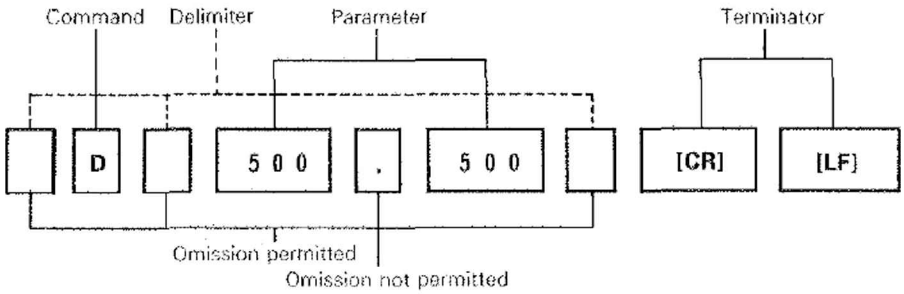


Fig. 2-1

●Command

This instructs the plotter what sort of operation and setting to perform. It uses a single upper or lower case character. In the example of Fig. 2-1, it instructs the plotter to draw a straight line from the current pen position to the coordinate that is specified in the parameters that follow the command.

●Parameter

This consists of coordinate values, characters and the like which are needed by commands. In the example of Fig. 2-1, the command to draw a straight line up to coordinate 500,500 uses parameters to designate the coordinate values.

There are three kinds of command: (1) a command without a parameter, (2) a command that requires a parameter and (3) a command with a parameter which can be omitted. The parameter's meaning and range varies depending on the command. The + sign of a numerical value parameter, such as a coordinate value, may be omitted. For commands whose parameter may be omitted, the default value of the parameter will be set if it is omitted. Depending on the command, even useless parameters may sometimes require a dummy value.

●Delimiter

This is a divider between command and parameter or parameter and parameter.
Either a space or a "," may be used as a delimiter. The + or − signs of the parameter may be substituted for them.
The delimiter between a command and a parameter may be omitted, but that between parameter and parameter cannot be omitted. It does not matter how many delimiters are used or where.
This manual uses the following standard format: D500,500

●Terminator

This marks the end of a command. If another command follows in succession, the terminator may be omitted, but not on any other occasion. [CR](CHR$(13))[LF](CHR$(10)) is used.
In the case of BASIC, executing the command in line ① will automatically transmit the data row in line ② from the Centronics port (parallel printer port).

① `LPRINT "M1000,1000"`

② [M] [1] [0] [0] [0] [,] [1] [0] [0] [0] [CR] [LF]

2.1.2 The Plotter Unit

When using DXY-GL commands, the plotting unit can be selected. The plotting unit is the actual length of 1 unit in the coordinate parameter. That is, if you wish to specify a distance of 1mm, input 10 when 1 parameter unit is 0.1mm, and input 40 when 1 parameter unit is 0.025mm.
However, a parameter whose unit is expressed with "mm" or "%" will have no multiplying effect on the plotting unit.
If RD-GL I commands have been set with the DIP switch, only 0.025mm can be selected for the plotting unit. But if the 0.1mm unit is selected with the DXY-GL command and then executed by calling RD-GL I with the "^" command, 0.1mm units are available for use.

2.2 DXY-GL Command Explanation

A	Circle Center

●FORMAT
Ax,y

●PARAMETER RANGE
−32768.0000 to +32767.4999

●RELATED COMMANDS
G, K

●EXPLANATION
Sets the center coordinates for circles and arcs using the x and y parameters. All coordinates are absolute coordinates, and parameters must be in the range −32768.0000 to +32767.4999. The "+" sign may be omitted. If a parameter outside the range is specified, it is ignored and the previous value set with the A command remains valid.
When coordinates are set with this command, they are valid until power is switched OFF or they are set again. With the use of the G and K commands in particular, specification of parameters exceeding the effective plotting area may be result in nothing being drawn at all.
If the A command is not executed, the G and K commands will draw a circle or circular arc around the center (0,0).

●EXAMPLE

```
LPRINT "A 1500,1500"
```

B	Line Scale

●FORMAT
B ℓ

●PARAMETER RANGE
0 to 32767.4999

●DEFAULT VALUE
"B 80"

●RELATED COMMANDS
L, ^LT

●EXPLANATION

Sets pitch for dotted lines, single dot-dash lines, and double dot-dash lines.

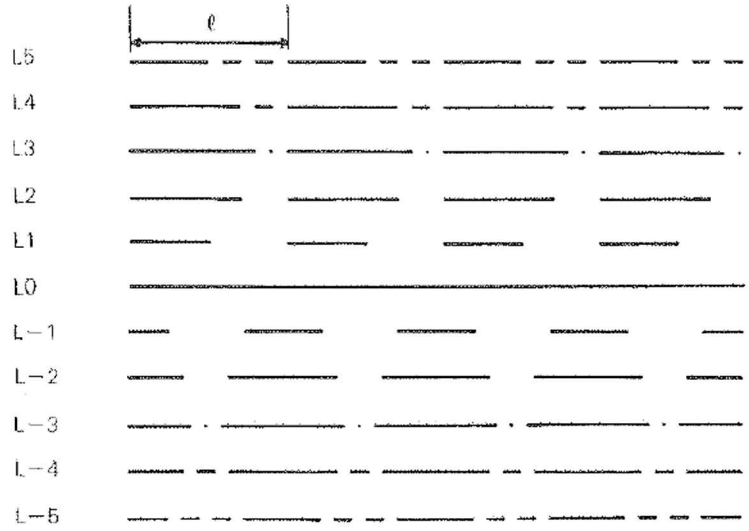


Fig. B-1

As ℓ is an integer value where $0 < \ell \leqq 32767.4999$, specification of a parameter larger than the line length will result in the plotter drawing a solid line.
When a negative parameter is specified with the L command, pitch is adjusted so that an integer value number of patterns is drawn in the plotting area. This will result in dimensions which differ slightly from the specifications.
The default value is ℓ =80.
When the pitch is set with this command, it is valid until power is switched OFF or the B or ^LT command is used to set a new pitch.

●EXAMPLE

```
10 ' *** "B" COMMAND ***
20 LPRINT "M1300,2200"
30 FOR I=20 TO 100 STEP 20
40   LPRINT "L2"
50   LPRINT "B";I      <-- Sets the pitch.
60   LPRINT "PP=";I
70   LPRINT "I1000,0"
80   LPRINT "R-1145,-200"
90 NEXT I
100 LPRINT "B80"
110 LPRINT "H"
```

This loop is executed five times.

C	Circle

●FORMAT
Cx,y,r,θ1,θ2 (,θd)

●PARAMETER RANGE
x,y,r : −32768.0000 to 32767.4999
θ1,θ2 : −32767° to +32767°
θd : 1° to 179.9999°

●RELATED COMMANDS
L, B, ^LT

●EXPLANATION
Draws circles and arcs centered on the specified coordinates (x,y). Parameter r is the radius of the circle or arc. x,y, and r must be within the range −32768.0000 to +32767.4999. θ1 is the start angle and θ2 is the completion angle, and θ1 and θ2 must be in the range −32767° to +32767°. The "+" sign may be omitted.
When θ1 < θ2 the circle or arc is drawn counterclockwise, and when θ1 > θ2 the circle or arc is drawn clockwise.
Specification of the parameter θd enables the drawing of a polygon. θd must be in the range 1° to 179.9999°, so that specification of θd as 60° will result in the drawing of a hexagon, and specification as 45° will result in the drawing of an octagon. When θd is omitted, the default value is 5°. When a large circle or arc is drawn, specification of θd as 5° or less permits drawing of a circle or arc with higher resolution.
θd is changed to an integer in order to divide (θ1 − θ2) equally.

●EXAMPLE

```
10 ' *** "C" COMMAND ***
20 LPRINT "C500,1500,300,0,360"      <-($\theta$1<$\theta$2:Counterclockwise)
30 LPRINT "C500,1500,200,360,0"      <-($\theta$1>$\theta$2:Clockwise)
40 LPRINT "H"
50 END
```

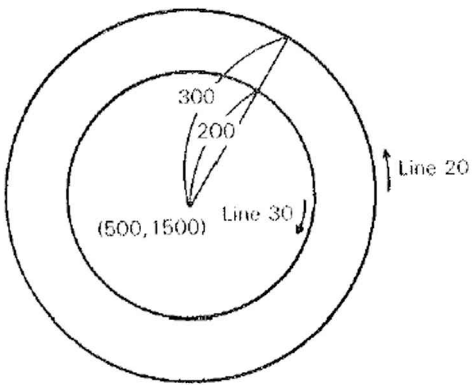


Fig. C-1

D	Draw

●FORMAT
D x1,y1,x2,y2 ··· xn,yn

●PARAMETER RANGE
−32768.0000 to +32767.4999

●RELATED COMMANDS
L, B, ^LT

●EXPLANATION
Draws lines (starting at the current pen position) between points (x1,y1), (x2,y2) ·· (xn,yn). All coordinates are absolute coordinates and any number of coordinates may be specified in the form (x coordinate, y coordinate). Parameters must be in the range −32768.0000 to +32767.4999, and decimal fractions are rounded up or down to the nearest integer. The "+" sign may be omitted. If a parameter outside the range is specified, if no parameter is specified, or if only one parameter is specified, an error occurs.
If an odd number of parameters (3 or more) has been specified, the pairs of parameters are executed in sequence but the last odd parameter results in an error.
If the specified coordinates are within the plotting area, the pen will move as specified. However, if they are outside the plotting area, the pen will move to the edge of the plotting area and then be raised.

●EXAMPLE

```
10 ' *** "D" COMMAND ***
20 LPRINT "D0,1000,1000,1000,1000,0,0,0"
30 LPRINT "H"
```

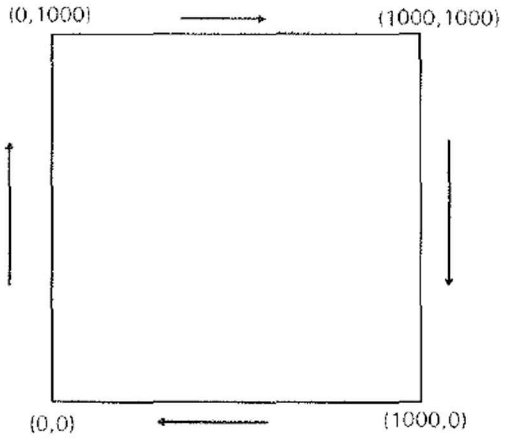


Fig. D-1

E	Relative Circle

●FORMAT

Er,θ1,θ2 (,θd)

●PARAMETER RANGE

r : −32768.0000 to +32767.4999
θ1,θ2 : −32767° to +32767°
θd : 1° to 179.9999°

●RELATED COMMANDS

L, B, ^LT

●EXPLANATION

As with the C and G commands, the E command draws circles and arcs. They are drawn starting from the current pen position. This enables drawing of a number of joined circle or arcs.
Parameter r is the radius of the circle or arc and must be within the range −32768.0000 to +32767.4999.
θ1 is the start angle and θ2 is the completion angle, and θ1 and θ2 must be in the range −32767° to +32767°.
The "+" sign may be omitted.
When θ1<θ2 the circle or arc is drawn counterclockwise, and when θ1>θ2 the circle or arc is drawn clockwise.
Specification of the parameter θd enables the drawing of a polygon. θd must be in the range 1° to 179.9999°, so that specification of θd as 60° will result in the drawing of a hexagon, and specification as 45° will result in the drawing of an octagon.
When θd is omitted, the default value is 5°. When a large circle or arc is drawn, specification of θd as 5° or less permits drawing of a circle or arc with higher resolution.
θd is changed to an integer in order to divide (θ1−θ2) equally.

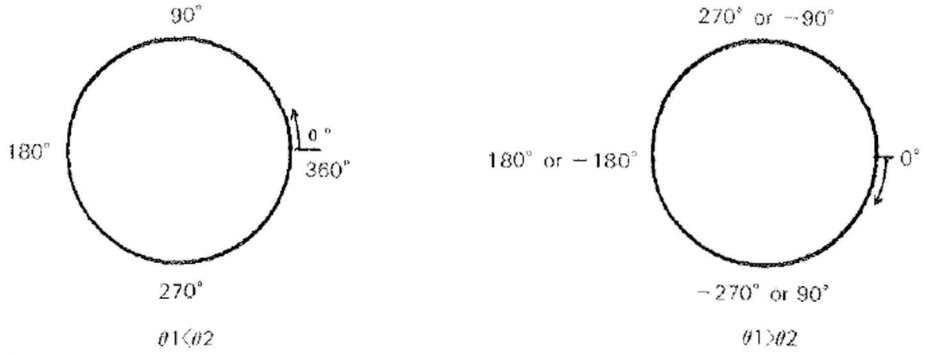


Fig. E-1

●EXAMPLE

```
10 ' *** "E" COMMAND ***
20 LPRINT "M1500,1500"
30 FOR I=0 TO 330 STEP 30
40   LPRINT "E200,";I;",";360+I
50 NEXT I
60 LPRINT "H"
```

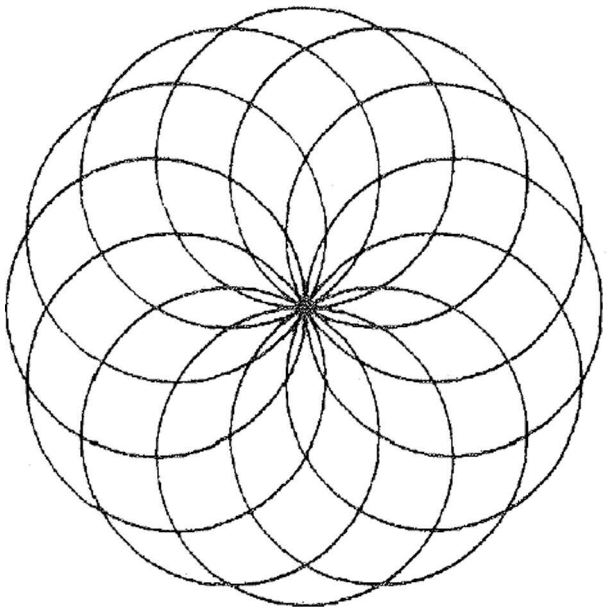


Fig. E-2

G	A + Circle

●FORMAT

Gr,*θ*1,*θ*2 (,*θ*d)

●PARAMETER RANGE

r : −32768.0000 to +32767.4999
*θ*1,*θ*2 : −32767° to +32767°
*θ*d : 1° to 179.9999°

●RELATED COMMANDS

A, L, B, ^LT

●EXPLANATION

This command will draw a circle or arc from a center specified by the A command.
Parameter r is used to specify the radius of the circle or arc and must be in the range −32768.0000 to +32767.4999. If a negative parameter is specified, the drawing start position (0°) is set at the same position as when a positive parameter is specified (180°).
$\theta 1$ is the start angle and $\theta 2$ is the completion angle, and $\theta 1$ and $\theta 2$ must be in the range −32767° to +32767°. The "+" sign may be omitted.
When $\theta 1 < \theta 2$ the circle or arc is drawn counterclockwise, and when $\theta 1 > \theta 2$ the circle or arc is drawn clockwise.
Specification of the parameter θd enables the drawing of a polygon. θd must be in the range 1° to 179.9999°, so that specification of θd as 60° will result in the drawing of a hexagon, and specification as 45° will result in the drawing of an octagon.
When θd is omitted, the default value is 5°.
When a large circle or arc is drawn, specification of θd as 5° or less permits drawing of a circle or arc with higher resolution.
This command is ignored when a parameter exceeding the relevant range is specified.
θd is changed to an integer in order to divide $(\theta 1 - \theta 2)$ equally.

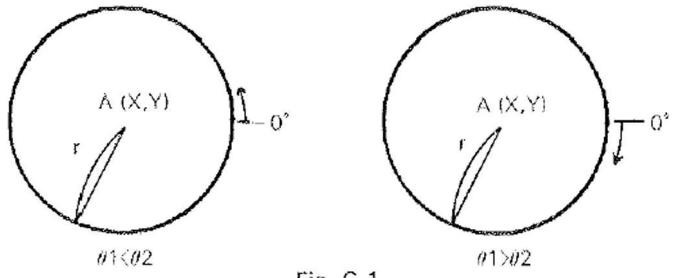


Fig. G-1

●EXAMPLE

```
10 ' *** "A","G" COMMAND ***
20 LPRINT "A500,1500"
30 LPRINT "G500,0,360"
40 LPRINT "H"
```

← Sets the coordinates of the center to (500,1500).
← Draws a circle with a radius of 500 at the center coordinates (500,1500).

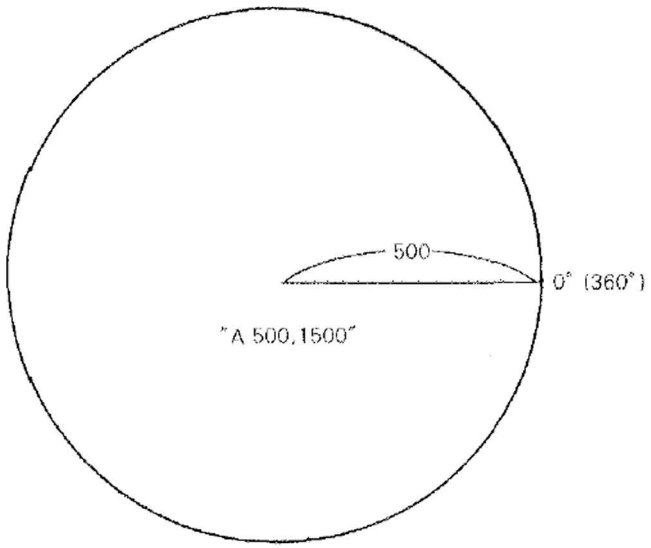


Fig. G-2

H	Home

●FORMAT
H

●EXPLANATION
If the pen carriage has the pen, it returns the pen to the pen stock and then moves to the view position.

●EXAMPLE

```
 1Ø ' *** "H" COMMAND ***
•2Ø OPEN "LPT1:" AS #1
 3Ø PRINT #1,"H"
```

I	Relative Draw

●FORMAT
IΔx1,Δy1,Δx2,Δy2, ··· Δxn,Δyn

●PARAMETER RANGE
−32768.0000 to +32767.4999

●RELATED COMMANDS
L, B, ^LT

●EXPLANATION
Draws a straight line from the current position to a point specified with the x and y increments (Δx1,Δy1) and then draws another straight line from the resultant position to a point specified with the next x and y increments (Δx2,Δy2).
All coordinates are relative coordinates and any number of coordinates may be specified in the form (x coordinate increment, y coordinate increment).
Numeric values that represent movement in the X to Y area from −32768.0000 to +32767.4999 (world coordinates) are effective as parameters, and decimals are rounded up or down to the nearest interger. The "+" sign may be omitted. If the specified coordinates full outside the world coordinates range, the following action cannot be guaranteed.
If a parameter outside the range of −32768.0000 to 32767.4999 is specified, if no parameter is specified, or if only 1 parameter is specified, an error occurs. If an odd number of parameters (3 or more) has been specified, the pairs of parameters will be executed in sequence but the last odd parameter will cause an error.

●EXAMPLE

```
10 ' *** "I" COMMAND ***
20 LPRINT "I0,1000,1000,0,0,-1000,-1000,0"
30 LPRINT "H"
```

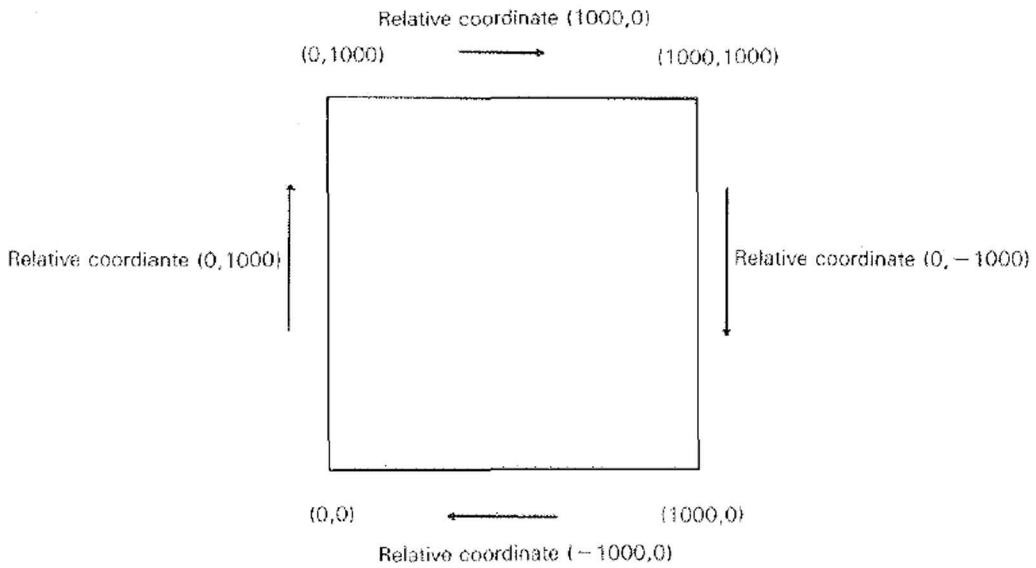


Fig. I-1

J	Pen Change

●FORMAT

Jn

●PARAMETER RANGE

0 to 8

●DEFAULT VALUE

"J1"

●RELATED COMMAND

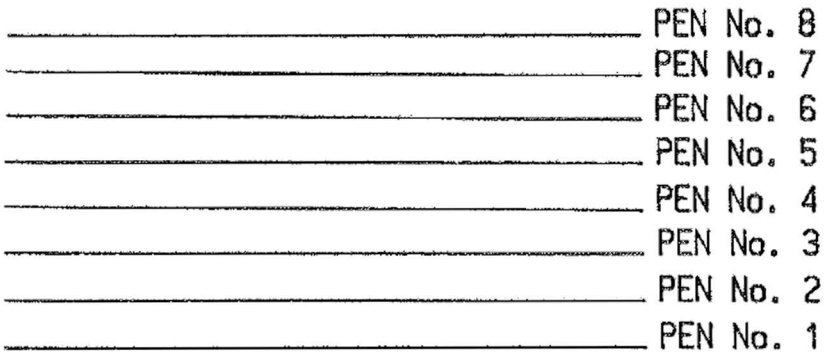
^SP

●EXPLANATION

Returns the current pen to its pen stock, replaces if with a different pen, and then returns to the position prior to execution of the command. When the current pen is specified, the pen carriage does not move. An error occurs if a parameter other than 0 to 8 is specified. When this command is not executed but the drawing command is executed using the default value n=1, the plotter will automatically draw with the No.1 pen. When "J0" is executed, the pen carriage will return the current pen to the pen stock and take no other until the next pen is specified.
When the J command is executed, the pen carriage will change pens and return to its original coordinate position.

●EXAMPLE

```
10 ' *** "J" COMMAND ***
20 FOR I=1 TO 8
30   LPRINT "J";I
40   LPRINT "M0,";I*100
50   LPRINT "I1000,0":LPRINT "P PEN No.";I
60 NEXT I
70 LPRINT "J0"
```



*Each pen draws a straight line.

Fig. J-1

K	A + %

●FORMAT

Kn, ℓ1, ℓ2

●PARAMETER RANGE

n : −9101 to +9101

ℓ1, ℓ2 : −32768.0000 to 32767.4999

●RELATED COMMAND

A, G, L, B, ^LT

●EXPLANATION

Draws segment and indication lines for circles and arcs drawn with the A and G commands. This command is only valid when the A command has been executed.

Parameter n specifies the angle for the segment line, the top of the circle being 0% (90°) and one revolution being equivalent to 100% (360°). Specification must be within the range −9101% to +9101%. The "+" sign may be omitted.

Specification of parameter n as a positive value results in the lines being drawn clockwise, and specification as a negative value results in the lines being drawn counterclockwise, from the outside to the inside of the circle and of the specified length.

Parameter ℓ1 specifies the distance of the end of the segment or indication lines from the center and must be in the range −32768.0000 to +32767.4999.

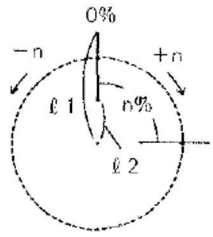


Fig. K-1

ℓ 2 specifies the distance from the center of the circle at which the segmentation or indication line begins, ℓ 1 specifies the distance from the center of the circle to the end of the line. These lines are drawn in accordance with the value (ℓ 1 − ℓ 2). With ℓ 1 = circle radius and ℓ 2 = 0, segmentation lines are drawn from the center to the periphery of the circle. If ℓ 1 is specified as being larger than the circle radius, and 0 < ℓ 2 < circle radius, indication lines are drawn from inside to outside the circle.

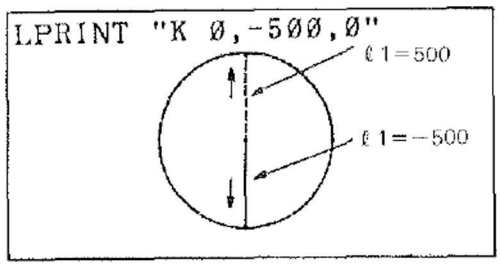


Fig. K-2

ℓ 1 and ℓ 2 may be specified as negative values. In such a case, drawing is from the 180° position as with a positive value. For example, when a negative value is specified for a circle of radius 500 drawn with the A and G commands, the following is drawn.
ℓ 1 is drawn starting with a position of n=50 (270°), which is 180° from n=0 (90°).

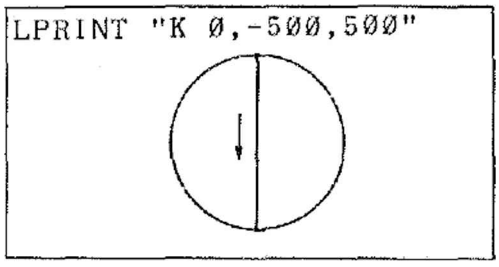


Fig. K-3

Since ℓ 2 is specified as 500, the plotter draws the value | ℓ 1 − ℓ 2| that is, a line of length 1000.

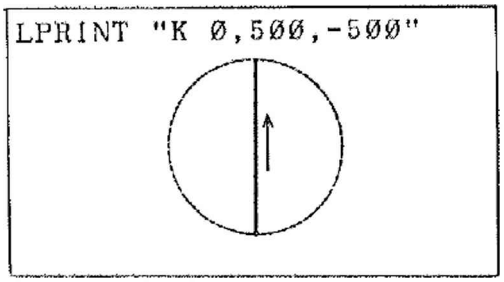


Fig. K-4

A line of length 1000 (ℓ 1 − ℓ 2) is drawn from the 0% drawing start position.

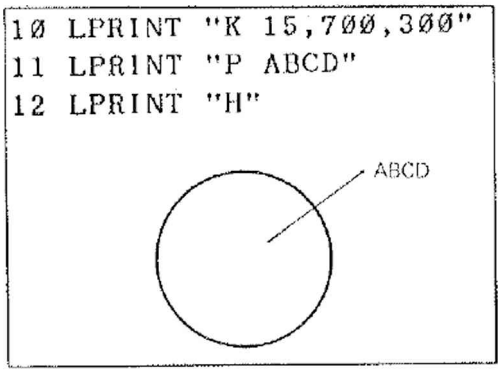


Fig. K-5

By setting ℓ 1> the radius of the circle, 0< ℓ 2 and ℓ 2<radius of the circle, a segment line can be drawn from the center to the circumference of the circle. This is used to draw pie graphs, the characters explaining the graph then being drawn with the use of the P command.

●EXAMPLE

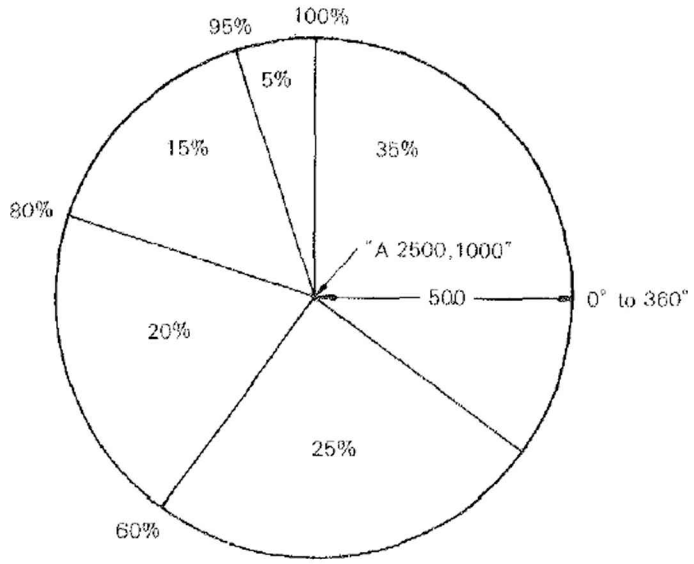
```
1ØØ ' *** "K" COMMAND ***
11Ø LPRINT "A25ØØ,1ØØØ"
12Ø LPRINT "G5ØØ,Ø,36Ø"
13Ø A=Ø
14Ø FOR X=1 TO 5
15Ø   READ B
16Ø   A=A+B
17Ø   LPRINT "K";A;",5ØØ,Ø"
18Ø NEXT X
19Ø LPRINT "H"
2ØØ DATA 35,25,2Ø,15,5
21Ø END
```

← Sets the coordinates of the center to (2500,1000).

← Draws a circle with a radius of 500.

← Reads the data in B.

← Draws segment lines in the circle at the A% position.



*Be careful of the position at 0° to 360° degrees.

Fig. K-6

L	Line Type

●FORMAT
Lp

●PARAMETER RANGE
−5 to +5

●DEFAULT VALUE
"L 0"

●RELATED COMMANDS
D, I, C, E, G, K, T, B, ^LT

●EXPLANATION
This command specifies the type of line.
It will only change the type of line to be drawn with the straight line commands D and I, the circle commands C, E and G, the segment line command K and the hatching command T.
The following 11 line types may be selected with p = −5 to 5.

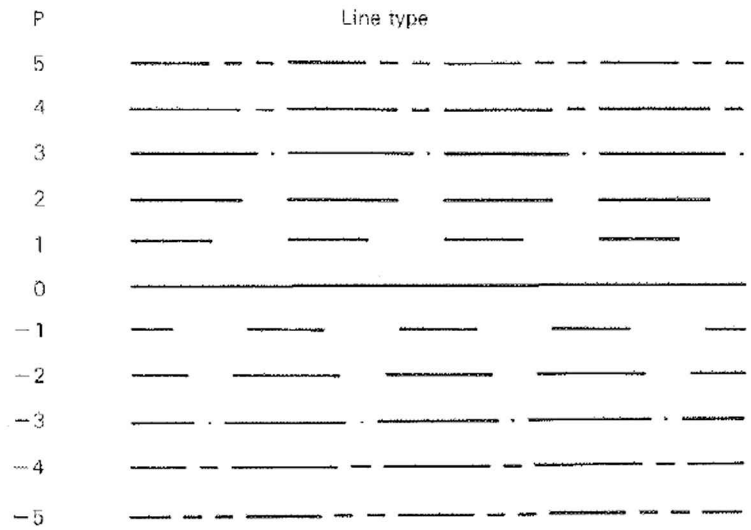


Fig. L-1

The start and end positions of the line will differ depending on whether a positive or negative value is specified.

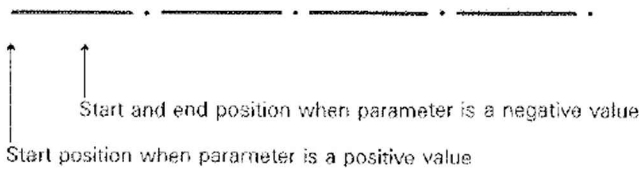


Fig. L-2

If, for example, a rectangle is to be drawn with single dot-dash lines, specification of the positive parameter (p=3) causes the end positions of the lines to vary depending on the line lengths to be drawn, as in Example 1 below. Therefore, specification of the negative parameter (p=−3) will properly adjust the start and end points of the drawing according to the line lengths, as in Example 2 below. In such cases the pitch may differ slightly, but when plotting circles or hatching with broken or single dot-dash lines, the uniformity of the start and end points produces a more attractive result.

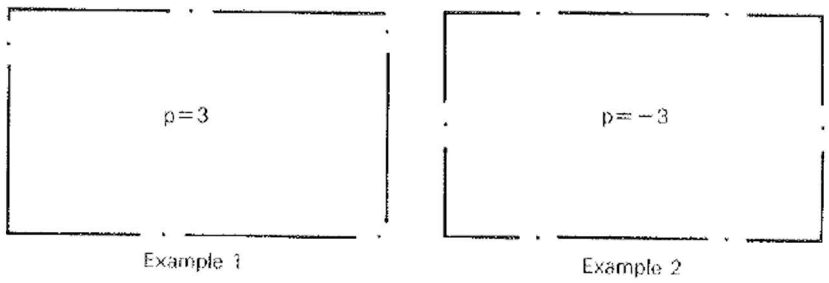


Fig. L-3

If a parameter outside the range −5 to 5 is specified, it is ignored and the previous value remains valid.
The initial value of p=0 produces a solid line.
The "B" command (dotted line pitch specification) may be specified anywhere in the program. When a line type is set with this command, it is valid until power is switched OFF or the L or ^LT command is used to set a new parameter.

●EXAMPLE

```
10 ' *** "L" COMMAND ***
20 LPRINT "M0,1200"
30 FOR I=-5 TO 5
40   LPRINT "L";I
50   LPRINT "PP=";I
60   LPRINT "I1000,0"
70   LPRINT "R-1120,100"
80 NEXT I
90 LPRINT "H"
```

← Specifies the line type.
← Draws a straight line of 1000 in the X direction.
← Moves −1120 in the X direction and 100 in the Y direction with the pen up.
← This loop is executed 6 times.

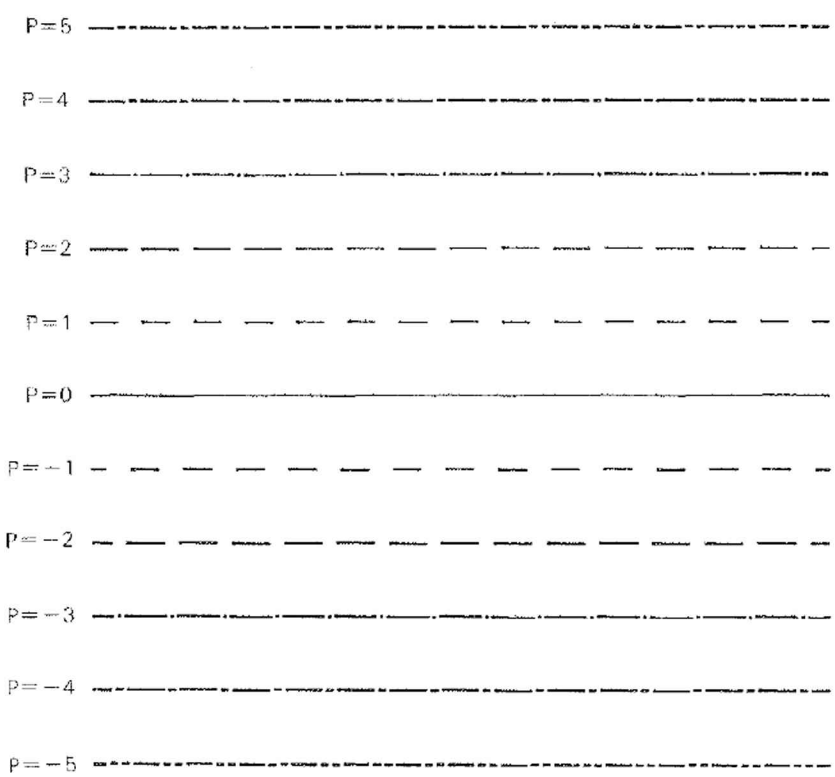


Fig. L-4

M	Move

●FORMAT

Mx,y

●PARAMETER RANGE

−32768.0000 to +32767.4999

●EXPLANATION

Moves the pen in the pen-up status to the point specified by the coordinate (x,y). All coordinates are absolute coordinates and any number of coordinates may be specified in the form (x coordinate, y coordinate). Parameters must be in the range −32768.0000 to +32767.4999 and decimal fractions are rounded up or down to the nearest integer. The "+" sign may be omitted. If a parameter outside the range is specified, if no parameter is specified, or if only one parameter is specified, an error occurs.

If an odd number of parameters (3 or more) has been specified, the pairs of parameters are executed in sequence and the last odd parameter results in an error.

However, if parameters are specified outside the effective plotting area but within the range of −32768.0000 to +32767.49999, the pen will not move. When the processed line data is within the effective plotting area, the pen will again start to move correctly.

●EXAMPLE

```
10 ' *** "M" COMMAND ***
20 LPRINT "M0,1000,1000,1000,1000,0,0,0"
```

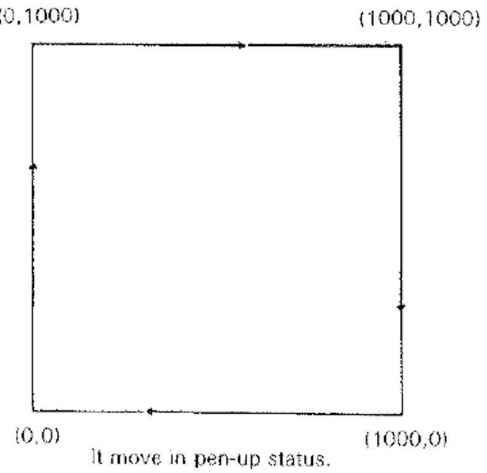


Fig. M-1

N	Mark

●FORMAT
Nn

●PARAMETER RANGE
1 to 15

●RELATED COMMANDS
S, ^SI, ^SR

●EXPLANATION
The parameters n=1 to 15 are used to draw the special symbols in the table below centered on the current pen position.
After drawing is completed, the pen carriage does not move to the next poisition as is the case when ordinary characters are drawn.
Only one parameter may be specified. Symbol size is specified with the S command.

n	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Special symbol	□	○	△	+	×	◇	✣	⧖	Z	Y	⌑	✳	⧗	I	✡

Table N-1

However, please note that when a part of the symbol extends beyond the drawing area, that part will not be drawn and the symbol itself will be incomplete.

●EXAMPLE

```
10 ' *** "N"ｺﾏﾝﾄﾞ ***
20 LPRINT "S14":LPRINT "M1200,500"
30 FOR I= TO 15
40   LPRINT "N";I:LPRINT "R100,0"
50 NEXT I
60 LPRINT "S3"
70 LPRINT "H"
```

←Sets the size to 14 and moves to coordinate (1200,500).

←Draws the special symbol and moves 100 relative to the X direction.

←Returns the character size to the default value.

□ ○ △ + × ◇ ✣ ⧖ Z Y ⌑ ✳ ⧗ I ✡

Fig. N-1

P	Print

●FORMAT

Pc1 c2 ··· cn

●RELATED COMMANDS

Character size : S, ^SI, ^SR
Character slant : ^SL
Character type : U, ^SA, ^SS, ^CS, ^CA
Direction : O, ^DR, ^DI

●EXPLANATION

Draws the content of the parameters (characters, symbols, or variables) following "P". The size of the characters and symbols drawn may be altered with the S command. The characters and symbols are drawn relative to the current pen position and the pen position is moved one space to the right after each character or symbol is drawn.

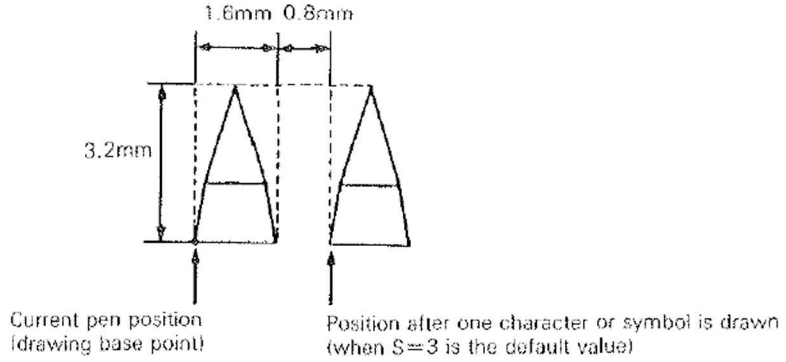


Fig. P-1

The characters from CHR$(32) to CHR$(126) are listed in Appendix C "Character Set Table" and can be selected with RD-GL I commands (^CS, ^CA, ^SA, ^SS).

●EXAMPLE

```
10 ' *** "P" COMMAND ***
20 LPRINT "M500,1500"
30 LPRINT "PABCDEFG"
40 LPRINT "H"
```

ABCDEFG

Fig. P-2

Q	Alpha Rotate

●FORMAT
Qn

●PARAMETER RANGE
0 to 3

●DEFAULT VALUE
"Q0"

●RELATED COMMANDS
^DR, ^DI

●EXPLANATION
Sets the drawing angle for characters drawn with the "P" and "N" commands. The parameter n must be an integer between 0 and 3. If a value outside this range is specified, it is ignored and the previously specified angle remains valid.
The initial value is n=0.
The character drawing angles are as follows.

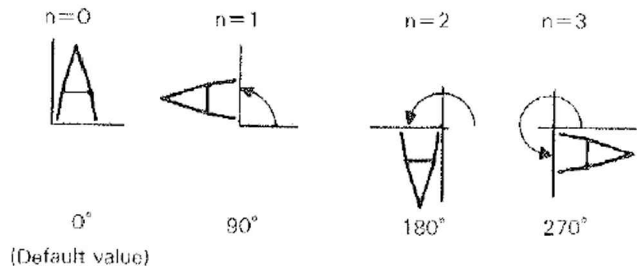


Fig. Q-1

When the drawing angle is set with this command, it is valid until it is set again or power is switched OFF.

●EXAMPLE

```
10 ' **** "Q" COMMAND ****
20 FOR I=0 TO 3
30   LPRINT "M1500,1500"
40   LPRINT "Q";I              ←Sets the drawing angle for characters.
50   LPRINT "P  Roland"
60 NEXT I
70 LPRINT "Q0"                 ←Returns to the default value.
80 LPRINT "H"
```

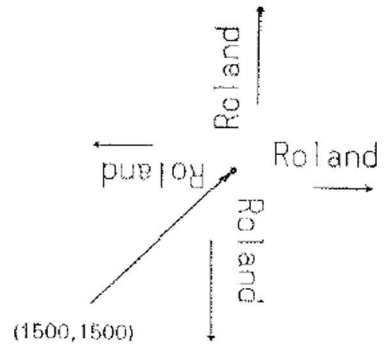


Fig. O-2

R	Relative Move

●FORMAT

RΔx,Δy

●PARAMETER RANGE

−32768.0000 to +32767.4999

●EXPLANATION

Moves the pen in the pen-up status from the current position to a point specified with the x and y increments (Δx1,Δy1). All coordinates are relative coordinates and any number of coordinates may be specified in the form (x coordinate increment, y coordinate increment).

The parameter must be in the range of −32768.0000 to +32767.4999, and decimal fractions are rounded up or down to the nearest interger. The "+" sign may be omitted.

However, if coordinates outside the absolute plotting area are specified, if a parameter outside the range of −32768.0000 to +32767.4999 is specified, if no parameter is specified or if only 1 parameter is specified, an error occurs. If an odd number of parameters (3 or more) has been specified, the pairs of parameters will be executed in sequence but the last odd parameter will cause an error.

●EXAMPLE

```
10 ' *** "R" COMMAND ***
20 LPRINT "R0,1000,1000,0,0,-1000,-1000,0"
```

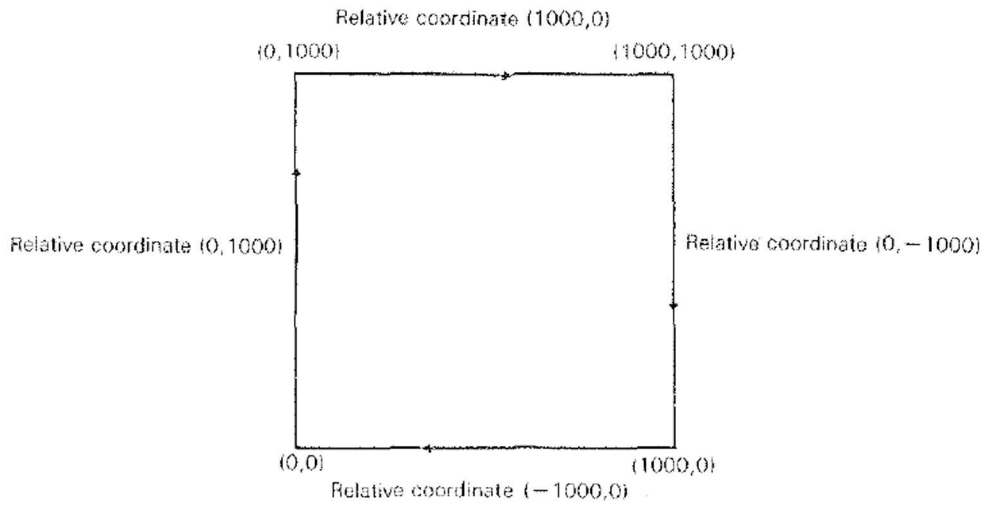


Fig. R-1

S	Alpha Scale

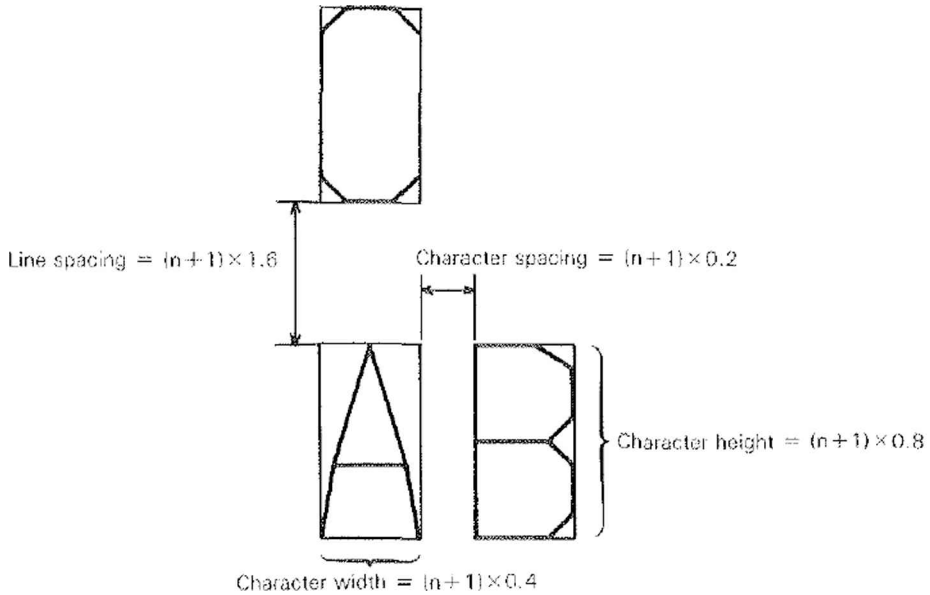
●FORMAT
Sn

●PARAMETER RANGE
0 to 127

●DEFAULT VALUE
"S3"

●RELATED COMMANDS
^LB, ^CP

●EXPLANATION
Sets the size of characters to be drawn with the "P" and "N" commands. It has no connection with the plotter units selected by the DIP switch.
The parameter n must be between 0 and 127 and, as shown in the table below, both the character and symbol size as well as the character interval are drawn with the value (n+1) when n=0.
When a parameter outside the range is specified, this command is ignored and the previously specified S command is valid.



When n=0 Character height : (0+1)×0.8=0.8mm
Character width : (0+1)×0.4=0.4mm
Character spacing: (0+1)×0.2=0.2mm
Line spacing : (0+1)×1.6=1.6mm

Fig. S-1

The default value is n=3.
When the size is set with this command, it is valid until it is set again or power is switched OFF.

●EXAMPLE

```
10 ' *** "S" COMMAND ***
20 LPRINT "M700,1500"
30 FOR I=5 TO 20 STEP 5
40   LPRINT "S";I              ← Sets the size.
50   LPRINT "PS";I
60 NEXT I
70 LPRINT "S3"                 ← Returns to the default value.
80 LPRINT "H"
```

Fig. S-2

T	Hatching

●FORMAT
Tn,x,y,d,t

●PARAMETER RANGE
n : 0 to 3
x,y,d : −32768.0000 to +32767.4999
t : 1 to 4

●RELATED COMMANDS
L, B, ^LT

●EXPLANATION
Parameter n must be in the range 0 to 3 and decimal fractions are rounded up or down to the nearest integer. It selects the following types of rectangles and hatching. If a parameter is specified outside the permissible range, it will be ignored.

n=1: Hatching only
n=2: Rectangle only
n=3:, n=0: Hatched rectangle

In the case of rectangles parameters x and y specify the lengths of the horizontal and vertical sides, and in the case of hatching they specify the lengths of the X and Y axes of the area to be hatched.

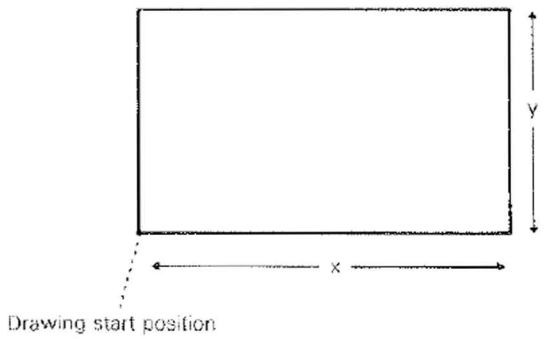


Fig. T-1

Parameter d specifies the intervals between hatching lines and must be in the range −32768.0000 to +32767.4999.
When only a rectangle is drawn (ie. n=2), this parameter d cannot be omitted as a dummy.

Fig. T-2

Parameter t specifies the hatching angle.
The hatching angle is specified as 0°, 45°, 90°, or 135° with the parameter t values 1, 2, 3, or 4. Decimal fractions are rounded up or down to the nearest integer. If a value other than one of these four is specified, the T command is ignored. When only a rectangle is drawn (ie:n=2), a value of 1 to 4 must still be entered as a dummy.

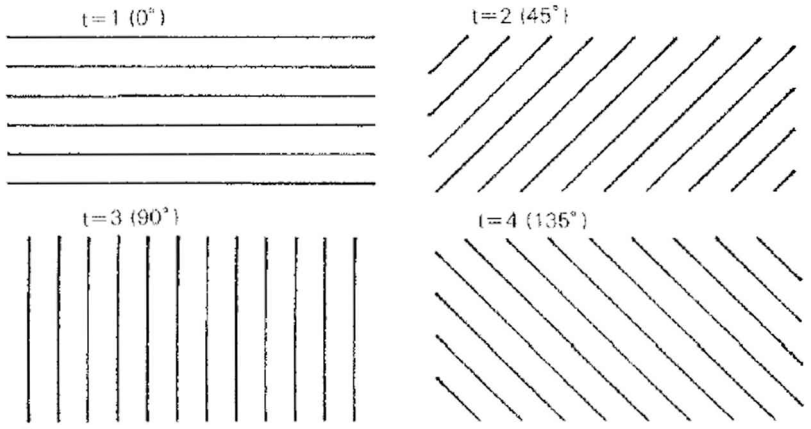


Fig. T-3

As well as hatching within a specified area, use of the hatching interval in combination with t=1 or t=3 permits drawing of tables as shown below.

```
LPRINT "T3,500,300,250,3"
LPRINT "T1,500,300,50,1"
```

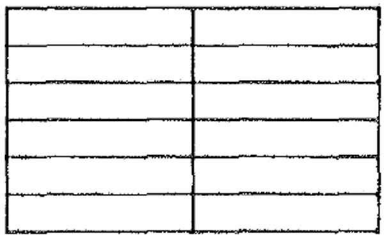


Fig. T-4

●EXAMPLE

```
10 ' *** "T" COMMAND 1 ***
20 LPRINT "M1000,200"
30 LPRINT "T3,400,200,20,2"
40 LPRINT "H"
```

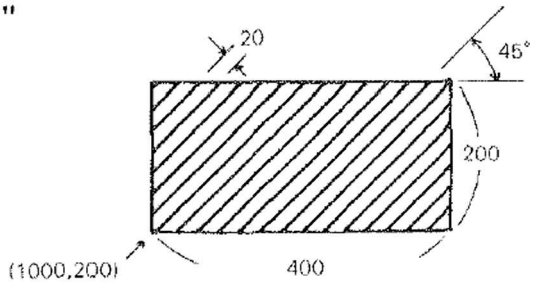


Fig. T-5

```
10 ' *** "T" COMMAND 2 ***
20 LPRINT "M500,1000"
30 LPRINT "T3,2500,1500,500,3"
40 LPRINT "T1,2500,1500,250,1"
50 LPRINT "H"
```

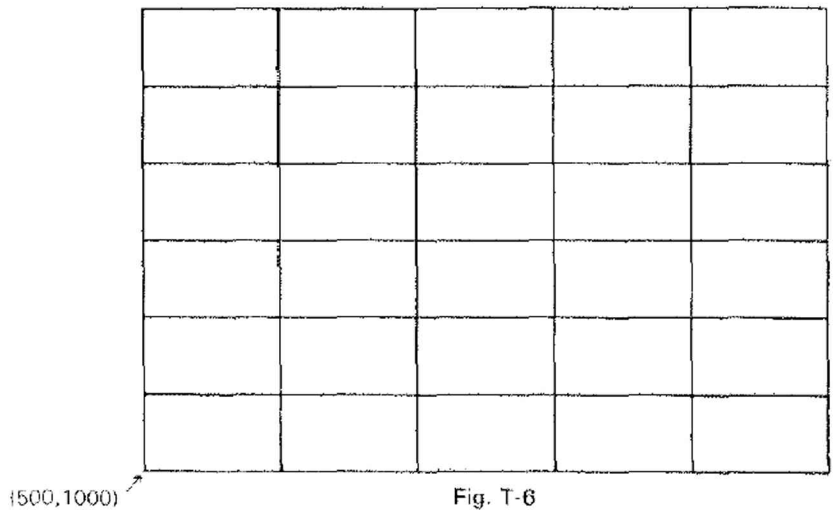


Fig. T-6

X	Axis

●FORMAT
Xp,q,r

●PARAMETER RANGE
p : 0,1
q : −32768.0000 to +32767.4999
r : 1 to 32676.4999

●EXPLANATION
Draws from the current pen position.
The Y coordinate axis is specified with p=0 and the X coordinate axis with p=1. If parameters other than 0 or 1 are specified, an error occurs.
q is used to specify the intervals on the scale and is a numeric value between −32768.0000 and +32767.4999. r specifies the number of times the scale is to be drawn and is a numeric value between 1 and 32767.4999. Both q and r are rounded up or down to the nearest integer.
If a negative value is specified for q, the coordinate axis is drawn in the negative direction (when p=0 the scale is drawn downwards from the current pen position, when p=1 the scale is drawn leftwards from the current pen position).

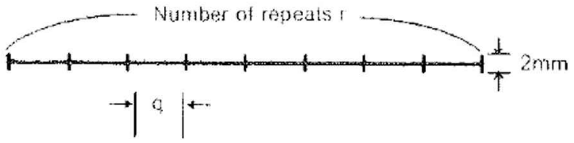


Fig. X-1

The length of the graduation ticks is 2mm regardless of the plotter units selected by the DIP switch. Naturally, any portions that extend beyond the plotting area will not be drawn, so please exerise care.

●EXAMPLE

```
10 ' *** "X" COMMAND ***
20 FOR N=0 TO 1
30   FOR I=-50 TO 50 STEP 100
40     LPRINT "M1500,1500"
50     LPRINT "X";N;",";I;",20"
60   NEXT I
70 NEXT N
80 LPRINT "H"
```

← Draws a coordinate axis and scale.

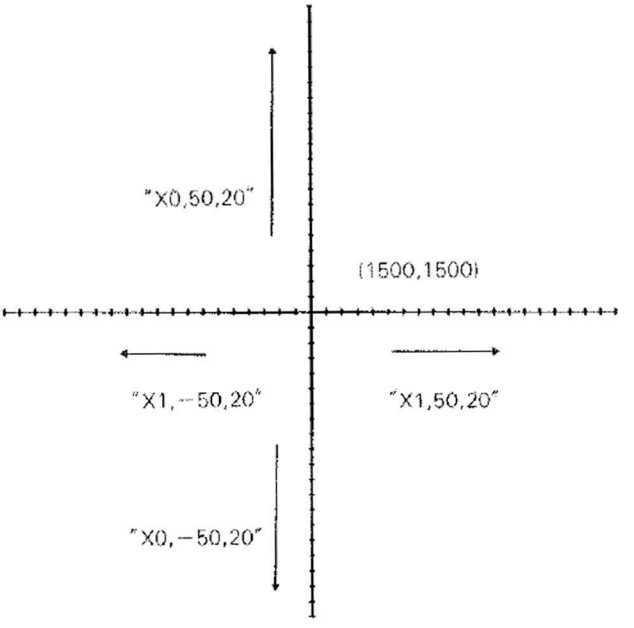


Fig. X-2

Y	Curve

●FORMAT
Ym,x1,y1,x2,y2, ··· xn,yn

●PARAMETER RANGE
m : 0 to 3
xn,yn : −32768.0000 to +32767.4999

m=0·····Open curved line in absolute coordinates
m=1·····Closed curved line in absolute coordinates
m=2·····Open curved line in relative coordinates
m=3·····Closed curved line in relative coordinates

●RELATED COMMANDS
L, ^LT

●EXPLANATION
This command connects the specified coordinates with a smoothly curved line. The specification of the m parameter determines whether an open or a closed curved line is drawn, and whether the absolute coordinate system or the relative coordinate system is used.

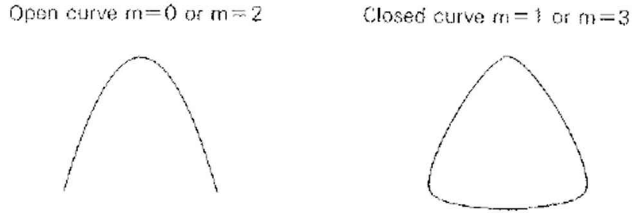


Fig. Y-1

When the m parameter is set to 0 or 1, the specified points are connected by an open or closed curve respectively in the absolute coordinate system following the sequence (x1,y1) → (x2,y2) ····→ (xn,yn).
When the m parameter is set to 2 or 3, the specified points are connected by an open or closed curve respectively in the relative coordinate system following the sequence (from the current pen position) → (Δx1,Δy1) → (Δx2,Δy2) ····→ (Δxn,Δyn).

Note: The drawing of a closed curved line begins from the second specified coordinate pair.

The value of m must be between 0 and 3, and decimal fractions are ignored.
The values of the coordinate parameters must be within the range of −32768.0000 to +32767.4999, and decimal fractions are rounded up or down to the nearest integer.
(In the relative coordinate system, the numeric values that can be expressed relatively must be in the range −32768.0000 to +32767.4999 on the x and y axes to be valid.)

Please note the following when using the Y command.

(1) When the m parameter is set to 0 or 1, failure to specify at least 3 pairs of coordinates will result in an error.
(2) When the m parameter is set to 2 or 3, failure to specify at least 2 pairs of coordinates will result in an error.
(3) Specifying points with the same, or extremely close coordinates, may result in a curve that is not smooth.
(4) Specifying points whose coordinates are separated widely, by comparison with the coordinates specified just before, may result in a curve that is not smooth.
(5) Be careful when specifying coordinates that fall on or close to the boundary of the plotting area. Any parts of the curve that extend beyond the plotting area will not be drawn.
(6) As shown below, specifying the same coordinate values immediately before and after a parameter specification will result in an error.

```
Y1,500,500,500,1000,1000,500,500,1000
```

Specification of the same coordinates

●EXAMPLE

```
10 ' *** "Y" COMMAND m=0 ***
20 LPRINT "Y0,500,500,500,1000,1000,500,1000,1000"
```

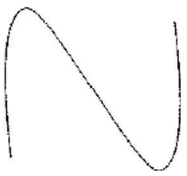


Fig. Y-2

```
10 ' *** "Y" COMMAND m=1 ***
20 LPRINT "Y1,500,500,500,1000,1000,500,1000,1000"
30 LPRINT "H"
```

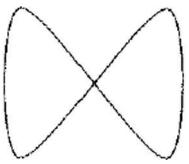


Fig. Y-3

_	Relative Curve

●FORMAT

_m,Δx1,Δy1,Δx2,Δy2, ··· Δxn,Δyn
(However, at least 3 pairs of coordinates are required.)

●PARAMETER RANGE

m : 0 to 1
Δxn,Δyn : −32768.0000 to +32767.4999

●RELATED COMMANDS

L, ^LT

●EXPLANATION

This Command draws a smooth curve connecting a set of relative coordinates in the sequence (Δx1,Δy1) → (Δx2,Δy2) ···→ (Δxn,Δyn). The specification of the m parameter (0 to 1) determines whether the curve will be open or closed, as shown in the figure below.

Note: The drawing of a closed curved line begins from the second specified coordinate pair.

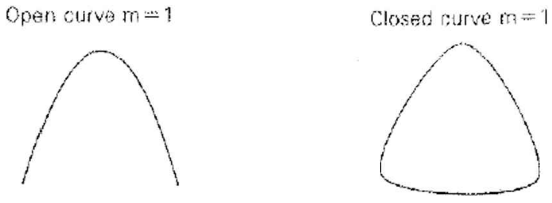


Fig._-1

The m parameter may be either 0 or 1, and decimal fractions are ignored. Coordinate parameters that can be expressed relatively must be in the range of −32768.0000 to +32767.4999 on the X to Y axes to be valid, and decimal fractions are rounded up or down to the nearest integer.
Please note the following when using this command.

(1) Failure to specify at least 3 pairs of coordinates will result in an error.
(2) Avoid specifying points with the same, or extremely close, coordinates.
(3) Avoid specifying points whose coordinate pairs are widely separated from each other.
(4) Be careful when specifying coordinates that fall on or close to the boundary of the plotting area. Any parts of the curve that extend beyond the plotting area will not be drawn.
(5) As shown below, specifying a parameter that returns to the same coordinate position in a previous parameter will cause an error.

_1,500,500,0,500,500,−500,−500,500

Same coordinate position

Note: When using the relative curve command, it is easy to overlook the specification of identical absolute coordinate values. Therefore, execise caution.

[Reference] The difference between the "__" command and the Y2 and Y3 commands.
The Y command begins drawing from the current pen position. However, the "__" command begins drawing from the first specified coordinate. To begin from the current pen position,

```
LPRINT "_Ø,Ø,Ø,15Ø,2ØØ,15Ø,-2ØØ,15Ø,2ØØ"
```

it is necessary to specify (0,0) as the first coordinate pair. Please note the following example.

●EXAMPLE

```
1Ø ' *** "_" COMMAND m=Ø ***
2Ø LPRINT "_Ø,5ØØ,5ØØ,Ø,5ØØ,5ØØ,-5ØØ,Ø,5ØØ"
3Ø LPRINT "H"
```

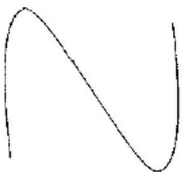


Fig.__-2

```
1Ø ' *** "_" COMMAND m=1 ***
2Ø LPRINT "_1,5ØØ,5ØØ,Ø,5ØØ,5ØØ,-5ØØ,Ø,5ØØ"
3Ø LPRINT "H"
```

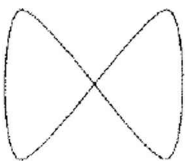


Fig.__-3

^	Up

The DXY-1000 series may be used by calling RD-GL I commands from the DXY-GL mode. For example, the RD-GL I scaling command may be called with the remainder of processing being performed with the DXY-GL commands.

●FORMAT

^ [RD-GL I command] [parameter] ··· (, [parameter]) [terminator (;)]

Note:	As input following "^" differs depending upon the RD-GL I command to be called, see the section on the RD-GL I commands for details.

●FUNCTION

RD-GL I commands are called in the DXY-GL mode by entering "^" followed by the RD-GL I command.

Note: DXY-GL commands cannot be called from the RD-GL I mode.

●EXAMPLE

Use of the RD-GL I SL command (the command for specifying character slant) will draw slanted characters.

```
10 ' *** "^" COMMAND ***
20 LPRINT "^SL1;"
30 LPRINT "S50"
40 LPRINT "P ROLAND"
50 LPRINT "^SL;"
60 LPRINT "S3"
70 LPRINT "H"
80 END
```

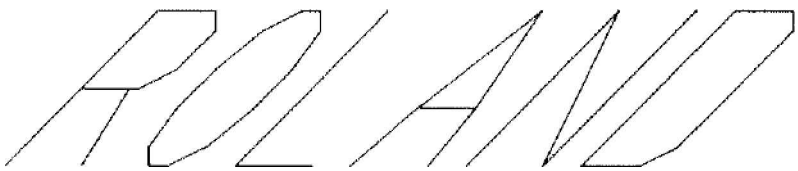


Fig. ^-1

CHAPTER 3
RD-GL I

RD-GL I (Roland DG Graphic Language) is a graphic language that has been systematically designed to operate a plotter efficiently. This language possesses 56 commands and has a high degree of flexibility, allowing each command to be set in detail for the plotter's individual movement.

When using commercial software, the user does not need to understand RD-GL I , since the software will analyze the user' s drawing, choose the commands and output them to the plotter. If you are writing you own program, however, first study the basic concepts underlying RD-GL I in this chapter and then learn the function of each command in section "3.9 RD-GL I Command Explanation" of CHAPTER 3.

- The follwing examples employ the BASIC language. Make any necessary modifications for your particular hardware or version of BASIC.
- All character codes (ASCII codes) use decimal notation.
- CHR$(character code) designates a character code.
- [ESC]CHR$(27) or [ESC] designates a control character.

3.1 Summary of RD-GL I

3.1.1 RD-GL I Commands by Type of Function

There are 56 commands in RD-GL I, and they can be roughly divided into the follow seven classifications:

①Initialization commands
The initial conditions and other settings.
②Coordinate control commands
For scaling or windows and the like.
③Pen control commands
Pen speed, carriage movement, drawing and the like.
④Enhancement drawing commands
Various drawing commands.
⑤Labelling commands
Commands that control labelling.
⑥Output commands
Commands for output of data from plotter.
⑦Digitize commands
Commands when using as digitizer.

※Output and digitize commands are only effective when the connection with the computer is a serial interface.

For an actual drawing, a program is created by combining the above commands. Each command function is explained in section "3.9 RD-GL I Command Explanation" of CHAPTER 3.

3.1.2 RD-GL I Format

The RD-GL I command format comprises the following four elements:

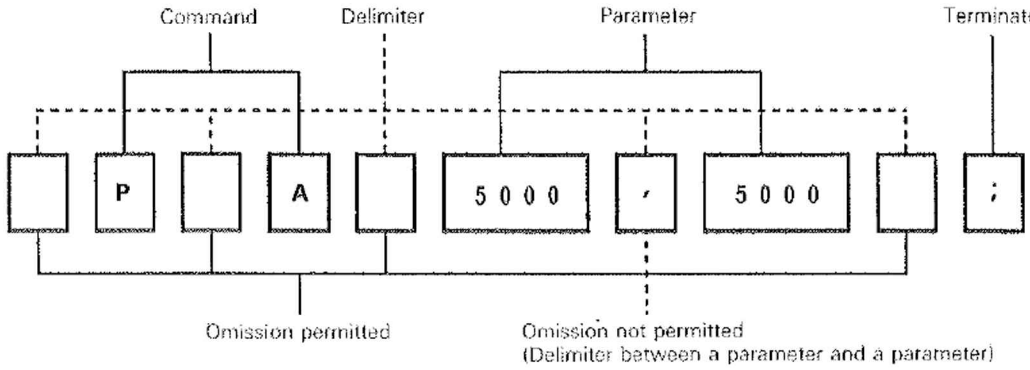


Fig. 3-1

●Command

This instructs the plotter what sort of operation and setting to perform. It uses two upper or lower case characters. In the example of Fig. 3-1,it instructs the plotter to move the pen to the coordinate specified by the parameter that follows the command.

●Papameter

This consists of coordinate values, characters and the like which are needed by commands. In the example of Fig. 3-1, the command to move to coordinate 5000,5000 uses parameters to designate the coordinate values.

There are three kinds of command: (1) a command without a parameter, (2) a command that requires a parameter and (3) a command with a parameter which can be omitted.

The parameter's meaning and range vary depending on the command. The + sign of a numerical value parameter, such as a coordinate value, may be omitted. For commands whose parameter may be omitted, the default value of the parameter will be set if it is omitted.

●Delimiter

This is a divider between command and parameter or parameter and parameter.

Either a space " " or a "," may be used as a delimiter.

The delimiter between a command and a parameter may be omitted, but that between parameter and parameter cannot be omitted. It does not matter how many delimiters are used or where.

```
P,A,5000,5000;
PA 5000 5000;
PA5000,5000;
PA5000+5000;
```

The delimiter may be written in the various ways shown above, but this manual uses the following standard format:

```
PA5000,5000;
```

●Terminator

This marks the end of a command. If another command follows in succession, the terminator may be omitted, but not on any other occasion. A semicolon ";" is used.
Since the LB command also considers the semicolon to be a character, [ETX] CHR$(3) should be used as a label terminator.

3.2 Initialization Commands

The "DF" and "IN" commands return a changed set value (filling interval, character size and the like) to the default value. Setting the "IN" command has the same result as turning the power off and then back on again. These commands are transmitted at the beginning of data.

Default Command	DF
Initialization Command	IN
Masking Input Command	IM

3.3 Coordinate Control Commands

Coordinate commands handle such tasks as setting the coordinate units and origin, setting the plotting area, rotating the coordinate axes and the like. They are used as needed.

3.3.1 Scaling

The coordinate system can be divided into two classes: the plotter coordinate system and the user coordinate system. Setting the user coordinates is called "scaling".
Scaling permits the setting of the coordinate units and the enlargement or reduction of drawings depending on the user's purpose.
The coordinate parameter for a command follows the plotter coordinate system until scaling is executed; after execution of scaling, it follows the user coordinate system while drawing.

●Plotter coordinate system

The plotter coordinate system is the one active in the original condition, and is determined by the paper size setting chosen with the DIP switch and by the expand mode selection.
The coordinate origin (0,0) is at the bottom left of the paper. In the plotter coordinate system,

1 plotter coordinate unit = 0.025mm

and thus to specify 1mm, 40 plotter coordinate units must be specified. If inches are used in the ANSI system, please refer to following conversion formula:

1 inch ≒ 1016 (plotter coordinate units)

●User coordinate system

In contradistinction to the plotter coordinate system, the user coordinate system can freely set any coordinate origin and coordinate unit. Once the user coordinate is set, however, the command coordinate parameter follows the user coordinate system from then on. It can freely set any coordinate units, but the actual values that can legally be employed are shown below:

−32768.0000 to +32767.4999

If coordinates are specified that fall outside the above permissible parameter setting range, an error will result. When setting the user coordinates, caution must be exercised so the plotting area does not go beyond the permissible parameter setting range.

●Setting scaling points P1 and P2

Scaling points P1 and P2 are the standard points used in scaling. Scaling is performed by setting P1 and P2 to points chosen by the user and then executing the SC command, which determines the coordinate values for each point. Simply setting P1 and P2 will not initiate scaling.

①Setting from the operation panel

Move the pen to your desired point with the positioning key and then press the P1 key while pressing the ENTER key to set this position to P1. In the same way, press the P2 key while pressing the ENTER key to set this position to P2.

If only P1 is set, P2 will move the same distance as P1 and then automatically be set to that point. In setting by IP command, an error will result if P1 is set to a point that would place P2 outside the plotting area. In setting by the operation panel, however, it is permissible to set P1 to a position that will place P2 outside the plotting area.
Pressing the P1 or P2 key on the panel will move the pen to the respective position, thus enabling you to confirm the current setting. If P2 is set to a point outside the plotting area, the pen will move toward it but stop at the boundary of the plotting area

②Setting by IP command

It is possible to set P1 and P2 by IP command. For example, if

```
"IPØ,Ø,4ØØØ,25ØØ;"
```

is sent, P1 will be set to (0,0) and P2 will be set to (4000,2500). At this time, the parameter's coordinate value must be a plotter coordinate. When rescaling, the active coordinate system is the user coordinate system but the parameter values will be the plotter coordinates.

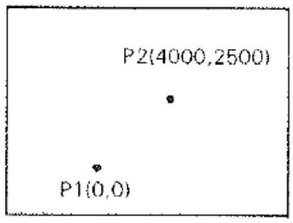


Fig. 3-2

In both the IP command and control panel setting, specifying only P1 will cause P2 to move the same distance as P1 and will then automatically set it to that point. For example, after executing the above statement to set P1 and P2, if

```
"IP1ØØØ,1ØØØ;"
```

is sent, P1 will be set at (1000,1000) and P2 will be set at (5000,3500).

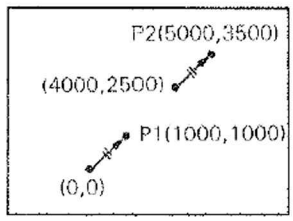


Fig. 3-3

●Scaling by SC command

The SC command determines the user coordinate values for P1 and P2 respectively after they have been set to the desired positions. For example, if

```
"IP1ØØØ,2ØØØ,4ØØØ,25ØØ;"
"SCØ,1,Ø,1;"
```

is sent, plotter coordinate P1(1000,2000) will become user coordinate (0,0) and plotter coordinate P2(4000,2500) will become user coordinate (1,1). (The SC command differs from the IP command in the parameter order.) Of course, a user coordinate can also be set outside P1 and P2 as shown in Fig. 3-4. The coordinate values in plotting from here on will be based on this user coordinate system.

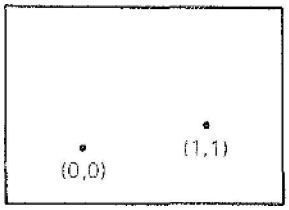


Fig. 3-4

If the SC and IP commands are executed in combination like this, the desired coordinate can be set to the desired position. By setting values useful in plotting, the programming load can be reduced.

P1 and P2 input command	IP
Scaling command	SC
Paper size setting command	PS

3.3.2 Windows

The plotting area set by the IW command is called the "window". A command to draw outside the window will not cause an error, but the segments lying outside the window will not be drawn. The default value of the window is the maximum plotting area.

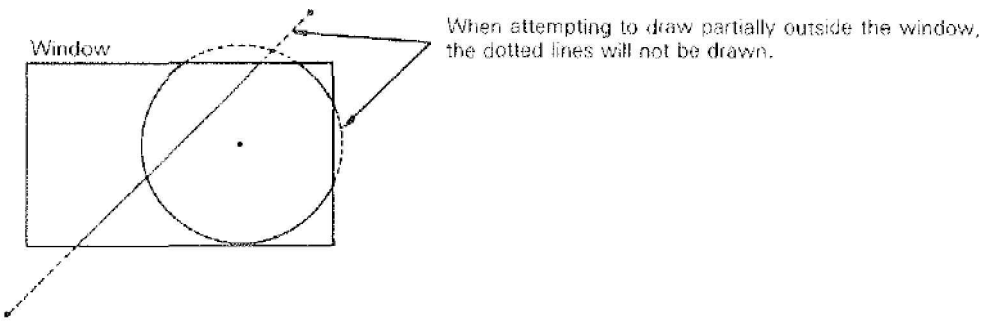
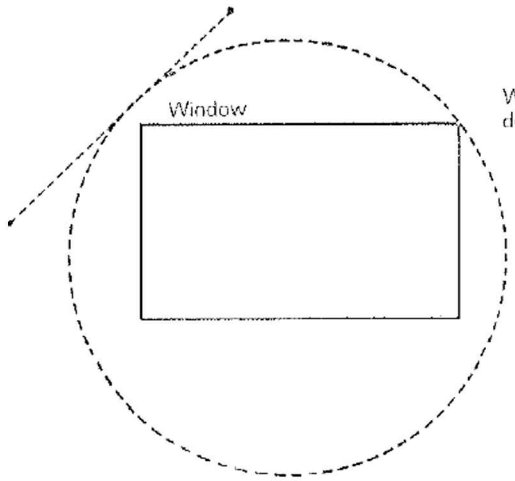


Fig. 3-5



When attempting to draw completely outside the window, nothing will be drawn.

Fig. 3-6

Command for inputting window	IW

3.3.3 Coordinate Axis Rotation

The coordinate axes can be rotated 90 degrees counterclockwise around a center at the origin (0,0). The RO command is used.

Command for rotating coordinates	RO

3.4 Pen Contorl Commands

3.4.1 Selection and Movement of Pen

If the drawing is simple enough, it can be done completely with pen control commands. [Example 3-1] shows a simple drawing statement. In this example, a straight line will be drawn from coordinate (1000,2000) to (4000,8000).

[Example 3-1]

```
10 LPRINT "SP1;"
20 LPRINT "PA;"
30 LPRINT "PU1000,2000;"
40 LPRINT "PD4000,8000;"
```

[Explanation]

Line 10 Selects No.1 pen.
Line 20 Specifies absolute coordinates.
Line 30 Moves the No.1 pen to (1000,2000) in pen-up position.
Line 40 Moves the pen to (4000,8000) in pen-down position. (Straight drawing)

Command for pen selection	SP
Command for drawing absolute coordinates	PA
Command for drawing relative coordinates	PR
Command for pen-up movement	PU
Command for pen-down movement	PD
Command for setting pen velocity	VS

3.5 Enhancement Drawing Commands

3.5.1 Drawing and Setting

Complex drawings are also possible by using only pen control commands, but RD-GL I possesses a variety of drawing commands. For example, it is easier to draw a rectangle by the "EA" command for drawing rectangles than by transmitting four separate commands to draw each side of the rectangle.

Drawing commands fall into two classes: commands that actually draw and commands that perform various settings needed for drawing but do not themselves draw. Filling the interior of a rectangle, for example, is done by the RA command, but the filling pattern is specified by the FT command. That is to say, the FT command (which does not draw) determines the filling pattern and then the RA command starts the actual drawing.

Command for drawing a rectangle at absolute coordinates	EA
Command for drawing a rectangle at relative coordinates	ER
Command for filling a rectangle at absoulte coordinates	RA
Command for filling a rectangle at relative coordinates	RR
Command for drawing a circle	CI
Command for drawing an arc at absolute coordinates	AA
Command for drawing an arc at relative coordinates	AR
Command for drawing a wedge	EW
Command for filling a wedge	WG
Command for specifying a filling pattern	FT
Command for specifying pen tip thickness	PT
Command for specifying line type	LT
Command for setting length of graduation	TL
Command for drawing X-axis graduations	XT
Command for drawing Y-axis graduations	YT

3.6 Labelling Commands

3.6.1 Drawing and Selecting Character Sets

The drawing of characters is done with the LB command. When the LB command is transmitted, the plotter enters labelling mode and draws the string of characters that follow the LB command. For example, if

```
LPRINT "LBABCDabcd";CHR$(3)
```

is sent, the plotter will draw "ABCDabcd" from the current pen location. [ETX]CHR$(3) in the above statement is a label terminator which is appended to the character string to release the plotter from labelling mode. If the label terminator is omitted, the next command sent will be interpreted as a string of characters. The label terminator can be changed with the DT command.

The character set to be used by the LB command is specified by the CS, SS, CA and SA commands, which are listed in Appendix C "Character Set Table".
The character codes for the characters that can be drawn are CHR$(33) to CHR$(126). Among the control characters that cannot be drawn, from CHR$(0) to CHR$(32), the following characters have special functions in labelling. The other control characters will be ignored.

[ETX]CHR$(3):	Terminates labelling mode
[BS]CHR$(8):	Moves left one space
[HT]CHR$(9):	Moves left half a space
[LF]CHR$(10):	Feeds one line down
[VT]CHR$(11):	Feeds one line up
[CR]CHR$(13):	Moves to head of line (carriage return)
[SO]CHR$(14):	Selects alternate character set
[SI]CHR$(15):	Selects standard character set

Various settings can be selected for the characters that are to be drawn. These include the size of character (SI, SR), the drawing direction (DI, DR) and the character slant (SL) among others.

Labelling commands	LB
Command for specifying absolute character size	SI
Command for specifying relative character size	SR
Command for specifying absolute character drawing direction	DI
Command for specifying relative character drawing direction	DR
Command for specifying character slant	SL
Command for defining user characters	UC
Command for specifying symbol mode	SM
Command for defining label terminators	DT
Command for controlling character position	CP

3.6.2 Character Sets

The DXY-1000 series provides 19 kinds of character sets. These are capable of drawing other character fonts besides English. Symbols and characters differ according to the character set.

Please refer to Appendix C "Character Set Table" for the characters in each character set.

●Selection of character set

Any two character sets you wish may be specified from the 19 character sets available to the plotter: the standard character set and the alternate character set. The standard character set is specified by the CS command, and the alternate character set by the CA command. The character set number is specified by the parameter that follows the command. When there is no parameter after the command or when initialization ("DF", "IN") has been commanded, both the standard and alternate character sets will be specified by the character sets that were selected with the DIP switches.

The selection of the character set to be used in the label is performed by the SS and SA commands. If the SS command is executed, the plotter will draw all subsequent characters in the standard character set; if the SA command is executed, the plotter will draw all subsequent characters in the alternate character set.

Here is a schematic illustration of the ideas in the above discussion.

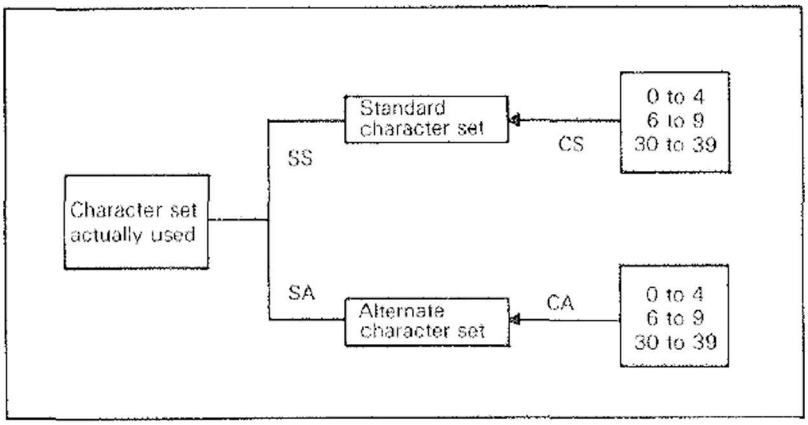


Fig. 3-7

If [SI]CHR$(15) is sent during labelling command (LB) mode, the current character set will be changed to the standard character set; if [SO]CHR$(14) is sent, it will be changed to the alternate character set.

The letters (or symbols) inside the dotted boxes in Appendix C, "Character Set Table", automatically execute a backspace before drawing. Therefore, when joining an added symbol to a letter, draw the letter first and only then draw the added symbols.

Command for specifying standard character set	CS
Command for selecting standard character set	SS
Command for specifying alternate character set	CA
Command for selecting alternate character set	SA

3.7 Output Commands (Only with Serial Connection)

When the output command is sent to the plotter, the plotter will be ready to output the data requested by the command to the computer. This includes the current coordinate values, the pen condition at those positions (up/down), error codes and the like. The computer can read this data any time. Since the computer must receive the plotter output signal, only a serial connection can be used. With a parallel connector, the computer cannot receive the data output by the plotter. It cannot, therefore, be used with this command.
This command is executed when data from the plotter is needed in drawing. [Example 3-2] shows a simplified example.

[Example 3-2]

```
100 OPEN "COM1:9600,N,8,1" AS #1
110 PRINT #1,"OP;"
120 INPUT #1,P1X,P1Y,P2X,P2Y
130 PRINT P1X,P1Y,P2X,P2Y
```

[Explanation]

Line 100 Opens the RS-232C port for communication.
Line 110 Transmits the output command OP for the coordinate values of scaling points P1 and P2.
Line 120 Reads each coordinate value.
Line 130 Outputs data to the display.

Command for outputting pen position (plotter coordinate) and pen state	OA
Command for outputting pen position (user coordinate) and pen state	OC
Command for outputting P1 and P2	OP
Command for outputting window	OW
Command for outputting coordinate values of maximum plotting area	OH
Command for outputting plotter coordinate units per 1mm	OF
Command for outputting plotter machine name	OI
Command for outputting optional parameter	OO
Command for outputting error code	OE
Command for outputting status	OS

3.8 Digitize Commands (Only with Serial Connection)

The DXY-1000 series can function not only as plotters but also as digitizers. The digitize command, like the output command, can only be used with a serial connection. It cannot be used with a parallel connection.

[Example 3-3] shows a simplified example.
The digitize mode is activated with the DP command (line 110). In this mode, the pen carriage is moved with [↑] [↓] [→] [←] to a point where the digitizing is required and then raised or lowered with the [PEN U/D] key.
Pressing the [ENTER] key will store the pen's user coordinate values and state (up or down) at the current position in the plotter and then exit digitize mode.
The OD command (line 130) permits output to the computer. Line 140 then instructs the computer to read data from the plotter.

[Example 3-3]

```
100 OPEN "COM1:9600,N,8,1" AS #1
110 PRINT #1,"DP;"
120 INPUT "READY";R
130 PRINT #1,"OD;"
140 INPUT #1,X,Y,P
150 PRINT X,Y,P
160 END
```

The method of using the OS command will be described next. When the [ENTER] key is pressed in digitize mode, bit 2 of the internal 8-bit status byte (bit value 4) will be set. Here is a sample program the reads the status byte contents with the OS command and , if the bit 2 value is "1", branches to the OD command.
In the subroutine from line 210 to line 250, the status byte is read and the bit 2 value searched. If its value is 1, the program will return from the subprogram to the main program and read the X and Y coordinate values and pen status from the plotter. Since the OD command clears this bit, a single output is possible at line 150 and then another read occurs at line 160 followed by another search of the status byte. Therefore, use of just the [ENTER] key makes it possible to digitize at many points.

[Example 3-4]

```
100 OPEN "COM1:9600,N,8,1" AS #1
110 DIM X(20),Y(20),P(20)
120 FOR I=1 TO 20
130   PRINT #1,"DP;"
140   GOSUB 210
150   PRINT #1,"OD;"
160   INPUT #1,X,Y,P
170   X(I)=X:Y(I)=Y:P(I)=P
180   PRINT "No.";I;"(";X(I);",";Y(I);") ";P(I)
190 NEXT I
200 END
```

```
210 ' *** STATUS BYTE CHECK ***
220 PRINT #1,"OS;"
230 INPUT #1,S
240 IF (S AND 4)=0 THEN 210
250 RETURN
```

Command for setting digitize mode	DP
Command for outputting digitzed coordinates	OD
Command for releasing digitize mode	DC

AA	Arc Absolute

●FORMAT

AA X,Y,θc (,θd) [terminator]

●PARAMETER RANGE

X,Y	:	Center coordinates	−32768.0000 to +32767.4999
θc	:	Center angle	−32768.0000° to +32767.4999°
θd	:	Resolution	−32768.0000° to +32767.4999° (default value: 5°)

●EXPLANATION

Draws an arc centered on the specified X and Y absolute coordinates, by the angle specified at θc, commencing from the current pen position. If more than a 360° angle is specified with θc, the drawing is done overlapping in the same location.

The resolution parameter specifies the smoothness of the arc.

The parameter is specified as an angle (°). The smoothest circles are mechanically drawn when θd is specified with 0°. θd's effective range is from 0° to 180°. If a value smaller than 0° is specified, 0° will be set; if a value large than 180° is specified, 180° will be set.

θd is changed to an integer in order to divide θc equally.

As well as drawing circles and arcs, resolution parameter θd may be altered to enable the drawing of a desired polygon.

●EXAMPLE

```
100 ' *** "AA" COMMAND ***
110 LPRINT "PA;PU8000,6000;"
120 FOR I=1 TO 5
130   READ A:D=360/A
140   LPRINT "SP";I;";PD;AA6000,5000,360,";D;";"
150 NEXT I
160 LPRINT "PU;":END
170 DATA 20,12,8,5,3
```

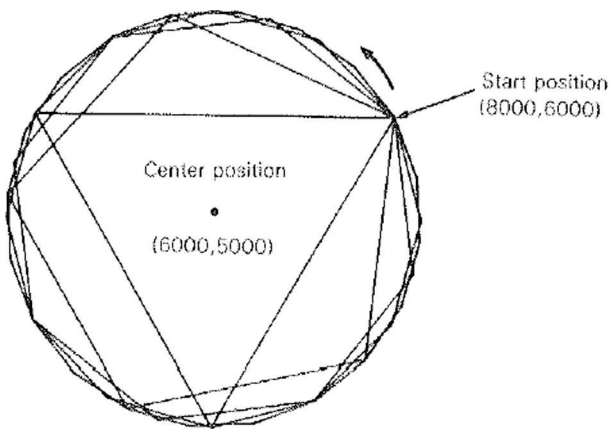


Fig. AA-1

AR	Arc Relative

●FORMAT

AR ΔX,ΔY,θc (,θd) [terminator]

●PARAMETER RANGE

ΔX,ΔY	:	Center coordinates	−32768.0000 to +32767.4999
θc	:	Center angle	−32768.0000° to +32767.4999°
θd	:	Resolution	−32768.0000° to +32767.4999° (default value: 5°)

●EXPLANATION

The AR command draws an arc, centered on the specified ΔX and ΔY relative coordinates, starting from the current pen position. If more than a 360° angle is specified with θc, the drawing is done overlapping in the same location. The angle of the arc is specified by θc. θd specifies the smoothness of the arc. The smoothest circles are mechanically drawn when θd is specified with 0°. θd's effective range is from 0° to 180°. If less than 0° is designated, 0° will be set and if more than 180° is designated, 180° will be set.
θd is changed to an integer in order to divide θc equally. The parameter value is specified in units of degree (°).

●EXAMPLE

```
100 ' *** "AR" COMMAND ***
110 LPRINT "SP1;PA;PU6000,2000;"
120 LPRINT "PD;AR0,-500,360,10;"
130 LPRINT "PU;"
```

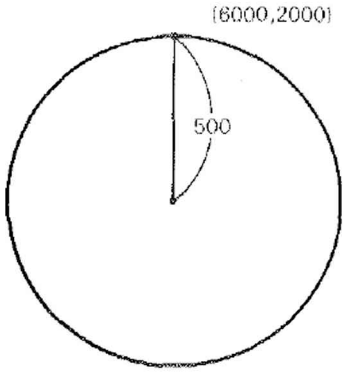


Fig. AR-1

CA	Designate Alternate Character Set

●FORMAT
CA character set number [terminator]
CA [terminator]

●DEFAULT VALUE
Designated by the DIP switch

●EXPLANATION
Designates an alternate character set in the same manner as the CS command.
Character set numbers can be from 0 to 4, 6 to 9, or 30 to 39. The CA command with a parameter out of the specified range will cause an error and the command will be ignored. Note that a character set designated by the CA command can only be printed when it is selected as an alternate character set by the SA command or [SO]CHR$(14). For details refer to "3.6.2 Character Sets" in Chapter 3.

●EXAMPLE

```
10 ' *** "CA" COMMAND ***
20 OPEN "LPT1:" AS #1
30 PRINT #1,"IN;SP1;PA1000,1000;"
40 PRINT #1,"CS0;CA7;"
50 PRINT #1,"SS;"
60 PRINT #1,"LBy=";CHR$(3)
70 PRINT #1,"SA;"
80 PRINT #1,"LB";CHR$(120);CHR$(3)
90 PRINT #1,"SS;"
100 PRINT #1,"LBx+1";CHR$(3)
110 PRINT #1,"SP0;"
```

$$y=\frac{1}{2}x+1$$

Fig. CA-1

CI	Circle

●FORMAT

CIr (,θd) [terminator]

●PARAMETER RANGE

r	:	Radius	−32768.0000 to +32767.4999
θd	:	Resolution	−32768.0000° to +32767.4999° (default value: 5°)

●EXPLANATION

The CI command draws a circle of radius r centered on the current pen position. The specification of parameter θd can be used to draw polygons. For example, θd=60° forms a hexagon and θd=45° forms an octagon. If θd is omitted, the default value of 5° is used.
θd specifies the smoothness of the arc. The parameter value is specified in units of degree (°). The smoothest circles are mechannically drawn when θd is specified with 0°. θd's effective range is from 0° to 180°. If less than 0° is designated, 0° will be set and if more than 180° is designated, 180° will be set.

●EXAMPLE

```
100 ' *** "CI" COMMAND ***
110 LPRINT "SP1;PA;PU6000,1500;"
120 LPRINT "CI1000;"
```

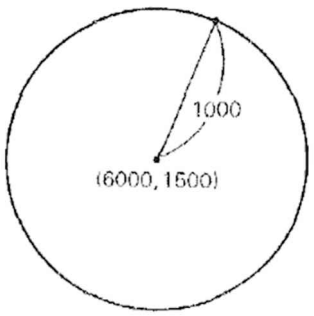


Fig. CI-1

CP	Character Plot

●FORMAT

CP number of character-space fields in X direction, number of character-space fields in Y direction [terminator]
CP [terminator]

●PARAMETER RANGE

−128.0000 to +127.9999

●EXPLANATION

The area of one character, including the spacing between characters, is called the character cell. The relationship between character cell and character size is shown in Fig. CP-1.

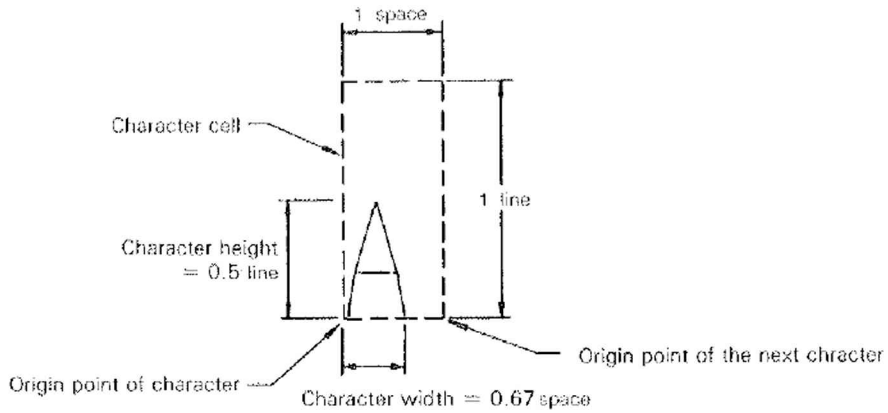


Fig. CP-1

Parameters take values in the range −128.0000 to +127.9999. A positive value moves the pen right or up, and a negative value moves it left or down. The parameter varies according to the character size. Note that the direction varies with print direction as shown in Fig. CP-2.

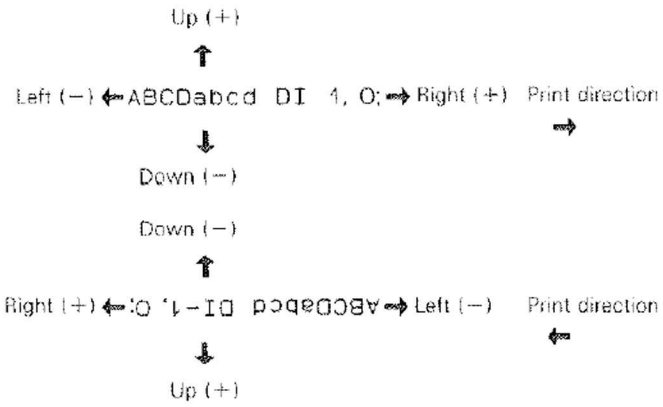


Fig. CP-2

The CP command with no parameters provides a carriage return [CR]CHR$(13) and line feed [LF]CHR$(10). Since the CP command designates the moving distance of the pen by the number of character-space fields, it can be more conveniently used in printing than the PA or PR command.
A printing example using the CP command follows. Note the flush left printing along the line. The following example uses the CP command to draw left jstified characters.

●EXAMPLE

```
100 ' *** CP COMMAND ***
110 LPRINT "IN;PA3000,3000;"
120 LPRINT "SP1;SI;"
130 LPRINT "LBCP INSTRUCTION";CHR$(3)
140 LPRINT "CP-7,-2;PR0,0;"
150 LPRINT "LBTHE";CHR$(3)
160 LPRINT "CP;LBCHARACTER";CHR$(3)
170 LPRINT "CP;LBPLOT";CHR$(3)
180 LPRINT "CP;LBCPINSTRUCTION,CP";CHR$(3)
190 LPRINT "SP0;"
```

CP INSTRUCTION

THE
CHARACTER
PLOT
CPINSTRUCTION,CP

Fig. CP-3

CS — Designate Standard Character Set

●FORMAT
CS character set number [terminator]
CS [terminator]

●DEFAULT VALUE
Designated by the DIP switch

●EXPLANATION
DXY-1000 series has nineteen character sets. These are used to plot character fonts other than English. The valid character set numbers are 0 to 4, 6 to 9, or 30 to 39. Refer to Appendix C "Character Set Table".
The CS command with a parameter other than these valid ones will cause an error and the command will be ignored.
If there is no parameter or the plotter is initialized, the character sets specified by the rear panel DIP switches are selected as the standard and alternate character sets.
For the relation to the CA, SA and SS commands refer to "3.6.2 Character Sets" in Chapter 3.

●EXAMPLE

```
10 ' *** CS COMMAND ***
20 OPEN "LPT1:" AS #1
30 PRINT #1,"IN;SP1;PA1000,1000;"
40 PRINT #1,"CS1;"
50 PRINT #1,"SS;"
60 PRINT #1,"LBtan(/3)=\3";CHR$(3)
70 PRINT #1,"SP0;"
```

$$\tan(\pi/3)=\sqrt{3}$$

Fig. CS-1

DC	Digitize Clear

(For serial connection only)

●FORMAT

DC [terminator]

●EXPLANATION

When the DC command is received, the digitize mode is terminated.
Coordinates are not stored. The DC command uses no parameter. For details, refer to "3.8 Digitize Commands" in Chapter 3.

●EXAMPLE

```
10 ' *** DC COMMAND ***
20 OPEN "COM1:9600,N,8,1" AS #1
30 PRINT #1,"DP;"
40 PRINT "Press ENTER key, then press RETURN key."
50 INPUT A
60 PRINT #1,"OD;"
70 INPUT #1,X,Y,P
80 PRINT "X =";X;"  Y=";Y;"  U/D =";P
90 PRINT #1,"DC;"
```

DF	Default

●FORMAT

DF [terminator]

●EXPLANATION

Sets the character size and slant to the default status (see Table DF-1) but the position of scaling points of P1 and P2 remain unchanged.

Function	Equivalent command	Default status
Plotting mode	PA;	Absolute corrdinates
Printing direction	DR;	Right horizontal
Line type	LT;	Solid line
Line pattern length	LT;	4% of diagonal line of P1 and P2
Input Window	IW;	Maximum plotting area
Character size	SR;	Width = 0.75% of (P2x−P1x) Height = 1.5% of (P2y−P1y)
Symbol mode	SM;	Off
Scale length	TL;	X scale = 0.5% of (P2x−P1x) Y scale = 0.5% of (P2y−P1y)
Standard character set	CS;	Value set by the DIP switch
Alternate character set	CA;	Value set by the DIP switch
Character set	SS;	Standard character set
Character slant	SL;	0°
Digitize mode	DC;	Cleared
Scaling	SC;	Not scaled
Pen speed	VS;	420mm/s
Label terminator	DT CHR$(3);	[ETX]CHR$(3)

Table DF-1

●EXAMPLE

```
10 ' *** DF COMMAND ***
20 OPEN "LPT1:" AS #1
30 PRINT #1,"DF;"
```

DI	Absolute Direction

●FORMAT
DI run, rise [terminator]
DI [terminator]

●PARAMETER RANGE
−128.0000 to +127.9999

●DEFAULT VALUE
"DI 1,0;"

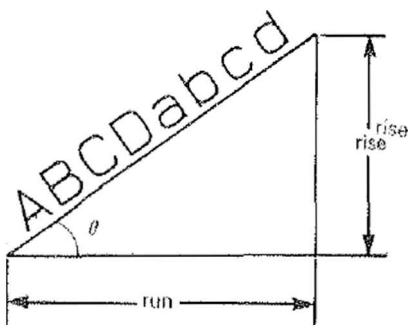
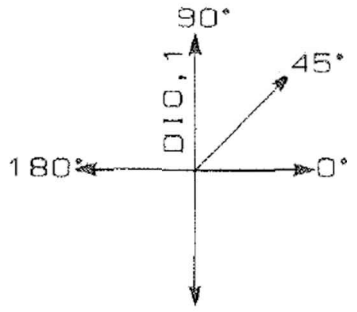


Fig. DI-1

●EXPLANATION
The DI command designates an absolute direction, independent of the positions of P1 and P2. The relationship between the two parameters, run and rise, designates a direction as shown in Fig. DI-1. Run and rise are values within −128.0000 to +127.9999. Rise=0 designates a horizontal direction, and run=0 a vertical direction. If both are zero, an error will result. For a known print angle θ, "DI"; cosθ;", ";sinθ;";" can be executed.



	run	rise
0°	1	0
45°	1	1
90°	0	1
135°	−1	1
180°	−1	0
225°	−1	−1
270°	0	−1
315°	1	−1

Fig. DI-2

The DI command with no parameters will default to the values "DI1,0;" (horizontal). If a single or three or more parameters are used, the command will be ignored.
A direction set by the DI command remains effective until a new DI or DR command is executed or the default values are enabled by the IN or DF command.

●EXAMPLE

```
100 ' **** "DI" COMMAND ****
110 LPRINT "IN;PA4500,4500;SP2;"
120 LPRINT "DI1,1;LB  -- 45deg--";CHR$(13);CHR$(3)
130 LPRINT "DI0,1;LB  -- 90deg--";CHR$(13);CHR$(3)
```

```
140 LPRINT "DI-1,1;LB  -- 135deg--";CHR$(13);CHR$(3)
150 LPRINT "DI-1,0;LB  -- 180deg--";CHR$(3)
160 LPRINT "DI-1,-1;LB  -- 225deg--";CHR$(13);CHR$(3)
170 LPRINT "DI0,-1;LB  -- 270deg--";CHR$(13);CHR$(3)
180 LPRINT "DI1,-1;LB  --315deg--";CHR$(3)
190 LPRINT "DI;LB  --DI  COMMAND--";CHR$(3)
```

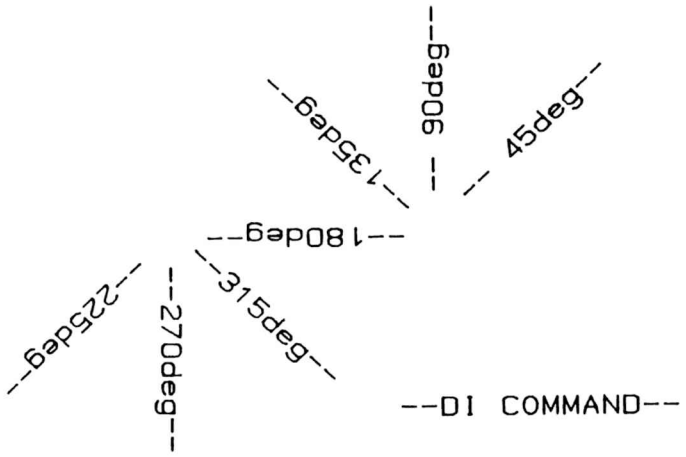


Fig. DI-3

DP	Digitize Point

(For serial connection only)

●FORMAT

DP [terminator]

●EXPLANATION

Receiving the DP command, the plotter is set to the digitize mode and ready to digitize. By pressing the ENTER key, X and Y coordinate values of the current pen position and pen up/down condition are stored in the plotter. At the same time, bit 2 of the status byte is set and data of the digitized point are ready to be output. The DP command uses no parameter. For details, refer to "3.8 Digitize Commands" in CHAPTER 3.

●EXAMPLE

```
10 ' *** "DP" COMMAND ***
20 OPEN "COM1:9600,N,8,1" AS #1
30 PRINT #1,"DP;"
40 PRINT "Press ENTER key, then press RETURN key."
50 INPUT A
60 PRINT #1,"OD;"
70 INPT #1,X,Y,P
80 PRINT "X =";X;"  Y =";Y;"  U/D =";P
90 PRINT #1,"DC;"
```

DR	Relative Direction

●FORMAT
DR run, rise [terminator]
DI [terminator]

●PARAMETER RANGE
−128.0000 to +127.9999

●DEFAULT VALUE
"DR 1,0;"

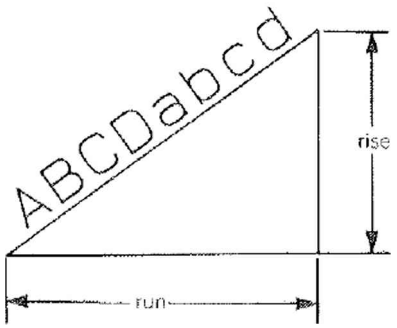
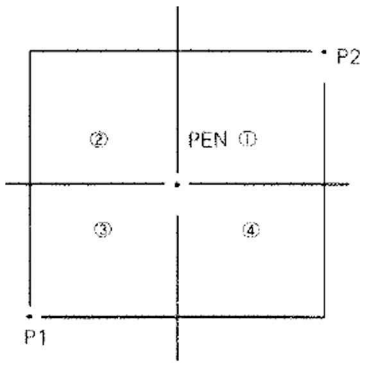


Fig. DR-1

●EXPLANATION
The DR command parameter "run" is specified by a percentage (%) of (P2x−P1x) and parameter "rise" is specified with a percentage (%) of (P2y−P1y). The relationship between "run" and "rise" is shown in Fig. DR-1. Note that the plotting direction varies with the positions of scaling points P1 and P2. The values of "run" and "rise" are within −128.0000 to +127.9999. "rise"=0 designates a horizontal direction, and "run"=0 designates a vertical derection. If both are 0, an error will result.
The DR command without a parameter defaults to the value "DR1,0;" (horizontal direction). If there is only 1 parameter, or 3 or more parameters, an error will result and the command will be ignored.
The sign of the parameters determines the quadrant of the plotting direction, with the current pen position as the original print.



	run	rise
①	+	+
②	−	+
③	−	−
④	+	−

Fig. DR-2

●EXAMPLE

```
10 ' *** DR COMMAND ***
20 OPEN "LPT1:" AS #1
30 PRINT #1,"IN;"
40 PRINT #1,"IP0,0,5000,10000;"
50 PRINT #1,"SP1;PA1000,1000;"
```

```
60 PRINT #1,"SI;DR1,1;LBDR1,1(1)";CHR$(3)
70 PRINT #1,"CP;IP0,0,10000,5000;"
80 PRINT #1,"SI;DR1,1;LBDR1,1(2)";CHR$(3)
90 PRINT #1,"SP0;"
```

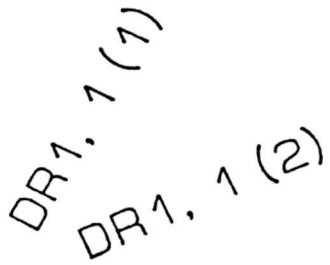


Fig. DR-3

DT	Defined Terminator

●FORMAT

DT character [terminator]

●EXPLANATION

The DT command is used to change the label terminator when the standard setting label terminator, **[ETX]**CHR$(3), cannot be used.

The ASCII control character **[NULL]**CHR$(0) cannot be defined as a label terminator, however, normal function of the character is also executed, or printed if it is a printable character. For example, when **[LF]**CHR$(10) is defined as a label teminator it releases the print mode and, at the same time, mades line feed. When "Z" is used as a label terminator, the print mode is released and "Z" is drawn at the end of the print. Normally, it is recommended to used a control code as a label terminator.

The DT command with no parameter does not reset the label terminator to **[ETX]**CHR$(3), because the command "DT;" defines ";" as a label terminator.

Therefore, use the DF or IN command, or execute "DT";CHR$(3);";", to reset the label terminator to **[ETX]**CHR$(3).

●EXAMPLE

```
10 ' *** DT COMMAND ***
20 OPEN "LPT1:" AS #1
30 PRINT #1,"IN;SP1;"
40 PRINT #1,"DT";CHR$(1)
50 PRINT #1,"PA1000,1000;LBSOH";CHR$(1)
60 PRINT #1,"SP0;"
```

SOH

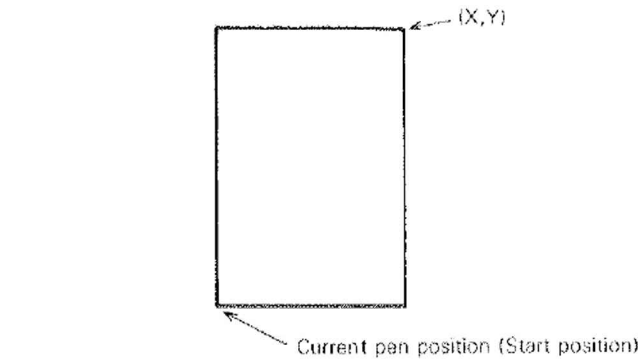
Fig. DT-1

EA	Edge Rectangle Absolute

●FORMAT
EA X,Y [terminator]

●PARAMETER RANGE
−32768.0000 to +32767.4999

●EXPLANATION
An EA command without parameters is ignored.
Draws a rectangle specified with the X and Y coordinate values. Drawing begins from the current pen position.



The pen returns to the start position after drawing is completed.

Fig. EA-1

The drawing direction and the position of the rectangle will change depending on the parameter values for the pen position, as shown in Fig. EA-2.

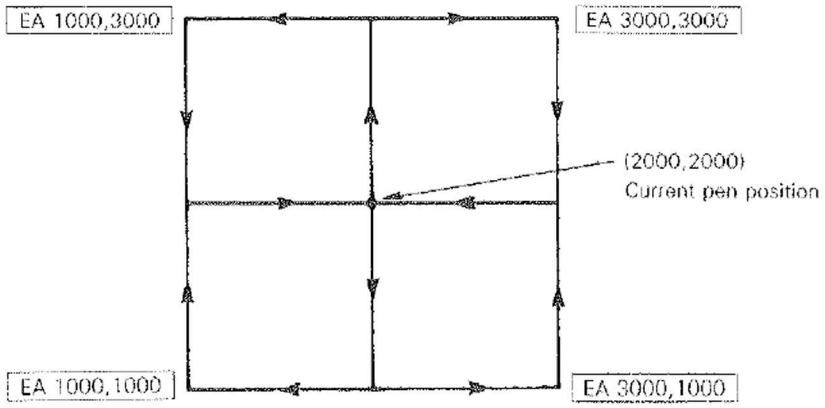


Fig. EA-2

●EXAMPLE

```
100 ' *** "EA" COMMAND ***
110 LPRINT "SP1;PA;PU1000,1000;"
120 LPRINT "EA2000,2000;"
```

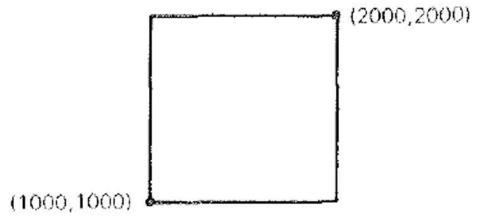


Fig. EA-3

ER	Edge Rectangle Relative

●FORMAT

ER ΔX,ΔY [terminator]

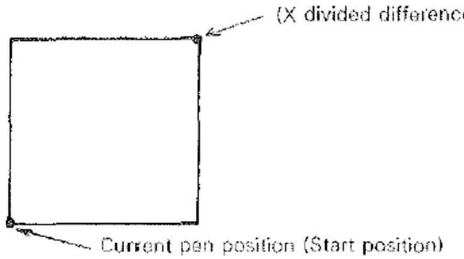
●PARAMETER RANGE

−32768.0000 to +32767.4999

●EXPLANATION

An ER command without parameters is ignored.

This command draws a rectangle whose diagonals are determined by the relative distance in X axis direction and the relative distance in the Y axis direction starting from the current pen position, as shown in Fig. ER-1.



The pen returns to the start position after drawing is completed.

Fig. ER-1

The drawing direction and the position of the rectangle will change depending on the parameter values for the pen position, as shown in Fig. ER-2.

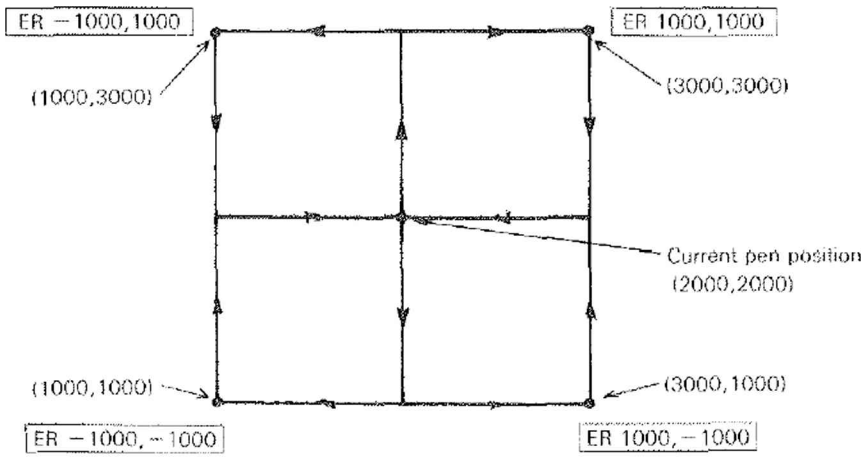


Fig. ER-2

●EXAMPLE

```
100 ' *** "ER" COMMAND ***
110 LPRINT "SP1;PA;PU2000,2000;"
120 LPRINT "ER1000,1000;"
```

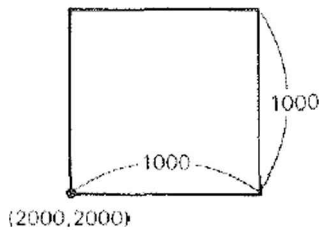


Fig. ER-3

EW	Edge Wedge

●FORMAT

EW r,θ1,θc (,θd) [terminator]

●PARAMETER RANGE

r	:	Radius	−32768.0000 to +32767.4999
θ1	:	Start angle	−32768.0000° to +32767.4999°
θC	:	Center angle	−32768.0000° to +32767.4999°
θd	:	Resolution	−32768.0000° to +32767.4999° (default value:5°)

●EXPLANATION

This command is ignored unless the parameters are specified.
When drawing is completed, the pen returns to the start position.
Since the base point varies with the sign of the radius parameter, care is required with its specification. The angle relative to the base point varies according to the sign of the start and center angle parameters.
The resolution specifies the smoothness of the circular arc of the wedge. The parameter is specified as an angle (°). The total number of chords per arc is limited to 90. For example, when $\theta c = 360^{\circ}$, resolution θd cannot be set to a value less than 4° no matter what value is specified.
The drawing direction changes depending on the sign of the parameter, as shown below in Fig. EW-1.

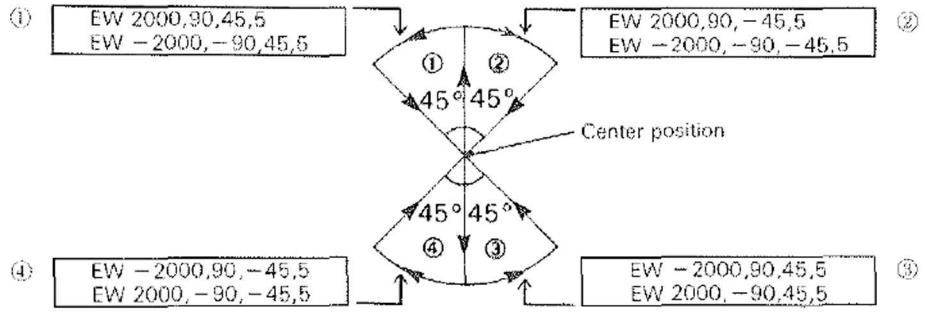


Fig. EW-1

●EXAMPLE

```
100 ' *** "EW" COMMAND ***
110 LPRINT "PA;PU2000,5000;"
120 FOR I=1 TO 4
130 READ A$
140 LPRINT "EW";A$;";"
150 NEXT I
160 DATA "-2000,-90,45,5","-2000,-90,-45,5"
170 DATA "2000,-90,-45,5","2000,-90,45,5"
```

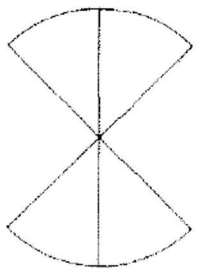


Fig. EW-2

FT	Fill Type

●FORMAT
FT n [,d [,θ]] [terminator]
FT [terminator]

●PARAMETER RANGE

n	:	Type	1 to 5
d	:	Spacing	0 to 32767.4999
θ	:	Angle	−32760° to +32760°

●DEFAULT VALUE
n=1
d=(P1−P2)×0.01
θ=0

●EXPLANATION
[n: Pattern]
The following three patterns are specified by number.
1:Bidirectional shading
2:Unidirectional shading
3:Hatching ()
4:Cross hatching ()
5:Ignored
If the pattern is not specified, the default value of 1 is set.

[d: Spacing]
Used to specify the spacing between the parallel lines used for hatching and cross hatching. When n is 1 or 2, this parameter is ignored and the value specified with the PT command is used.
When d is not specified, the d value specified with the previous FT command is set. If there is no previous FT command, the default value (1% of the P1,P2 spacing) is set.
d is ignored if specified as 0, and the PT command value specified at that time is used.

[θ: Angle]
Specifies the angle of the lines used for shading and hatching in increments of 45°. If 0 is specified, horizontal lines are drawn, if 90 is specified, vertical lines are drawn and if 45 is specified, lines at 45° are drawn. If the angle is not specified, or if other than multiples of 45 are specified, the value specified with the previous FT command is set. If there is no previous FT command, 0 is set.

●EXAMPLE

```
10 ' *** FT COMMAND ***
20 OPEN "LPT1:" AS #1
30 PRINT #1,"SP1;PT0.3;"
40 PRINT #1,"PA500,1000;"
50 PRINT #1,"FT1,0,0;"
60 PRINT #1,"RR500,500;"
70 PRINT #1,"PA1000,1000;"
80 PRINT #1,"FT4,100,45;"
90 PRINT #1,"RR500,500;"
100 PRINT #1,"SP0;"
```

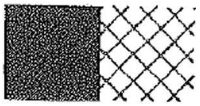


Fig. FT-1

IM	Input Mask

●FORMAT

IM error mask value [terminator]
IM [terminator]

●EXPLANATION

The error mask value is the sum of the error mask bit values (the numbers in Table IM-1) of the errors to be determined. If a set bit error occurs, the ERROR LED on the operation panel will flash. For example, the standard error mask value 223 (128+64+16+8+4+2+1) will cause the ERROR LED to flash when an error other than Error No.6 occurs.
Since Error No.4, No.7 and No.8 are not used, an error mask value of 23 (which excludes these three) means the same as the standard set value 223.

Error mask bit value	Error No.	Meaning
1	1	Unrecognizable command issued
2	2	Wrong number of parameters
4	3	Parameter out of range
8	4	Unused
16	5	Unusable character designated
32	6	Coordinate overflow
64	7	Unused
128	8	Unused

Table IM-1

The OE command can be used to learn the error contents when the POWER/ERROR LED of the plotter is flashed.
The error mask value is set to 223 by the standard or initial setting.
The IM command with no parameter or with a parameter out of the range sets the error mask value to the standard setting value, 223.

●EXAMPLE

```
10 ' *** IM COMMAND ***
20 OPEN "LPT1:" AS #1
30 PRINT #1,"IM222;"
40 PRINT #1,"XX;"
```

IN	Initialize

●FORMAT
IN [terminator]

●EXPLANATION
Performs the following settings in addition to the default settings of the DF command.
(1) Pen up (PU;)
(2) Sets the scaling points to the default values (IP;)
(3) Clears any errors and the sets the third bit of the status byte
(4) Sets the rotate coordinate system to the default values (RO;)

●EXAMPLE

```
10 ' *** IN COMMAND ***
20 OPEN "LPT1:" AS #1
30 PRINT #1,"IN;"
```

IP	Input P1 and P2

●FORMAT
IP P1x,P1y (,P2x,P2y) [terminator]

●PARAMETER RANGE AND DEFAULT VALUE
The parameter range will be the range of the maximum plotting area, as shown in Table IP-1, that can be changed by DIP switches 1-⑥, 1-⑦ and 1-⑧.
Decimal fractions are rounded down and values that are not included in Table IP-1 will be considered errors.

Paper size	X	Y
A3(ISO)	0 ~ 16158	0 ~ 11040
A4(ISO)	0 ~ 11040	0 ~ 7721
B(ANSI)	0 ~ 16640	0 ~ 10365
A(ANSI)	0 ~ 10365	0 ~ 7962
EXPAND	0 ~ 17272	0 ~ 11880

Table IP-1 Maximum plotting area

Default values vary with drawing size.

Paper size	P1x,P1y	P2x,P2y
A3(ISO)	170,602	15370,10602
A4(ISO)	603,521	10603,7721
B(ANSI)	522,259	15722,10259
A(ANSI)	250,596	10250,7796

Table IP-2 Default values of P1, P2

●EXPLANATION

The coordinates of P1 and P2 are specified in plotter coordinates. Therefore, the X and Y coordinates must be within the range shown in Table IP-1 in order to insure that P1 and P2 are within the maximum plotting area.

The IP command without parameters sets P1 and P2 to the initial values shown in the Table IP-2.

The IP command is used to set P1 and P2 to given values or reset them to the initial values. P1 and P2 (the scaling points) serve to determine the positional relationship between the plotter coordinate system inherent in the plotter and the user coordinate system whose scale is provided by the user. The user coordinate scale is specified by the SC command.

If the IP command is executed with P2x and P2y omitted, P2x and P2y are moved automatically the same distance that P1x and P1y are moved. That is, the value P2x−P1x and P2y−P1y become the same after execution of the IP command as before execution of the IP command. However, if P1 is set so that P2 falls outside the plotting area, an error will occur and the value will be ignored.

●EXAMPLE

```
10 ' *** IP COMMAND ***
20 OPEN "LPT1:" AS #1
30 PRINT #1,"IN;SP1;PA0,0;"
40 PRINT #1,"IP0,0,2000,1000;"
50 PRINT #1,"SC0,100,0,100;"
60 PRINT #1,"EA100,100;"
70 PRINT #1,"SP0;"
```

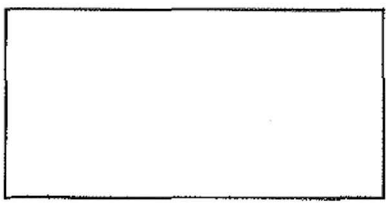


Fig. IP-1

IW	Input Window

●FORMAT

IW X1 lower left, Y1 lower left, X2 upper right, Y2 upper right [terminator]
IW [terminator]

●PARAMETER RANGE AND DEFAULT VALUE

The default values and range of the parameters are the maximum plotting areas as shown in Table IW-1, and can be changed by DIP switches 1-⑥, 1-⑦ and 1-⑧. If the window is set beyond this range, the window will be the boundary of the maximum plotting area without error.

Paper size	X	Y
A3(ISO)	0 ~ 16158	0 ~ 11040
A4(ISO)	0 ~ 11040	0 ~ 7721
B(ANSI)	0 ~ 16640	0 ~ 10365
A(ANSI)	0 ~ 10365	0 ~ 7962
EXPAND	0 ~ 17272	0 ~ 11880

Table IW-1 Maximum plotting area

●EXPLANATION

Four parameters are determined as plotter coordinates and indicate the X and Y coordinates of the lower left corner and upper right corner of the window.
If the X1 value of the lower left corner is greater than the X2 value of the upper right corner, or the Y1 value of the lower left corner is greater than the Y2 value of the upper right corner, the parameter values are automatically changed, with X2 always greater than X1 and Y2 greater than Y1.
The window is set to the default values after the power is switched ON or the IN or DF command is executed.
This command is used to restrict the plotting area when the paper is smaller than the plotting area or when a part of a drawing is to be plotted.

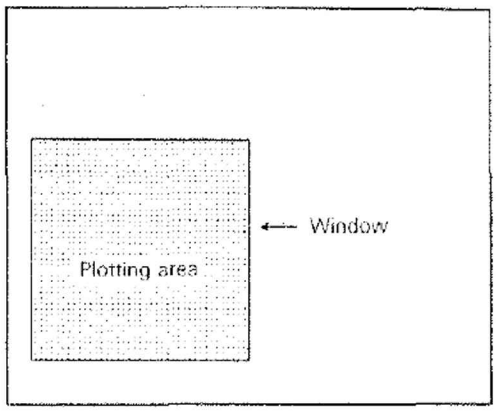


Fig. IW-1

●EXAMPLE

```
10 ' *** IW COMMAND ***
20 OPEN "LPT1:" AS #1
30 PRINT #1,"IN;IW1000,1000,2000,2000;"
40 PRINT #1,"SP1;PA1500,1500;"
50 PRINT #1,"CI550;"
60 PRINT #1,"SP0;"
```

LB	Label

●FORMAT

LB character string [label terminator]

●RELATED COMMANDS

DT, CS, SS, CA, SA, DI, DR, SI, SR, SL

●EXPLANATION

The LB command sets the plotter to print mode. In print mode, all input is interpreted as character strings until a label terminator is received. The label terminator is initially set to [ETX-]CHR$(3), which can be changed using the DT command.

Character sets that are used in printing with the LB command include those designated by the CS, SS, CA, or SA command, ASCII codes 33 to 127. The direction of the character string is specified by the DI or DR command, the size by the SI or SR command, and the slant by the SL command.

In printing by the LB command, the current pen position is the left lower corner of the first character.

Therefore, before executing the LB command, the pen should be moved to the location where labelling is to begin by using one of the plot commands (PA, PR, or CP) or by the front panel controls. Portions projection out of the drawing area will not be drawn.

After that, when a carriage return [CR]CHR$(13) is received, the pen returns to the lower left corner of the first character but no line feed is made.

To excute a carriage return and line feed, both carriage return [CR]CHR$(13) and line feed [LF]CHR$(10) should be entered. Refer to the example in the paragraph on the CP command in this chapter.

Other special codes are back space [BS]CHR$(08), vertical tab [VT]CHR$(11) and horizontal tab (1/2 backspace) [HT]CHR$(9). Variables can, of course, be used as character strings. Two or more consecutive variables are plotted with no blank between them by using a semicolon (;) as a delimiter between the variables. When a comma (,) is used as a delimiter, the variables are printed at the right end within a specified space (depending on the computer).

●EXAMPLE

```
10 ' *** LB COMMAND ***
20 OPEN "LPT1:" AS #1
30 PRINT #1,"SP1;PA1000,1000;"
40 PRINT #1,"LBLABEL  COMMAND";CHR$(3)
50 PRINT #1,"SP0;"
```

LABEL COMMAND

Fig. LB-

LT	Line Type

●FORMAT

LT pattern number (, 1 pitch length) [terminator]
LT [terminator]

●PARAMETER RANGE

Pattern number : −128 to +127
Pitch length : 0 to +127.9999 (%)

●DEFAULT VALUE

Solid line
4%

●EXPLANATION

The LT command without parameters defines a solid line. The type of dotted line varies with the pattern number as follows:

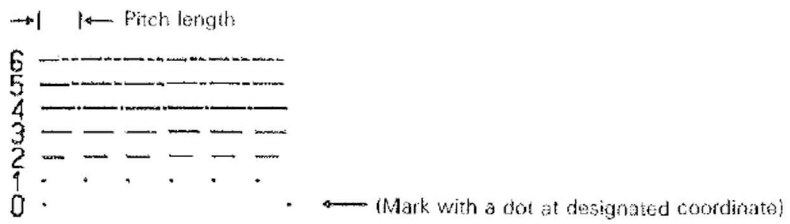


Fig. LT-1

A pattern number parameter in the range +7 to +127 is ignored and decimal fractions are truncated.
A parameter between −128 and −1 defaults to a solid line. A parameter greater than 128 or less than −128 will cause an error.
The pitch length parameter is effective when the pattern number is within +1 to +127. This parameter represents the pitch length as a percentage of the diagonal line between scaling points P1 and P2.
When no pitch length is designated, it is set to 4%.

●EXAMPLE

```
10 ' *** LT COMMAND ***
20 PRINT #1,"LT5;"
30 PRINT #1,"SP1;PR;PD2000,0,0,1000,-2000,0,0,-1000;PU;"
```

Fig. LT-2

OA	Output Actual Position

(For serial connection only)

●FORMAT

OA [terminator]

●EXPLANATION

When the OA command is received, the plotter is ready to output the following three values in ASCII code.

X,Y,P [TERM]

X and Y are the integer values of plotter coordinates. P indicates the pen condition, 0 for a pen up and 1 for a pen down condition. [TERM] is an output terminator for the RS-232C interface. For details, refer to "5.4 Device Control Command ESC.M" in Chapter 5.
This command can be used to manually move the pen to a desired position where a character or pattern is to be drawn and to determine its coordinates, which will facilitate pen positioning and window setting.
Before using the command in an actual program, open a file by using the OPEN statement.

●EXAMPLE

```
10 ' *** "OA" COMMAND ***
20 OPEN "COM1:9600,N,8,1" AS #1
30 PRINT #1,"OA;"
40 INPUT #1,X,Y,P
50 PRINT X,Y,P
```

OC | Output Commanded Position

(For serial connection only)

●FORMAT
OC [terminator]

●EXPLANATION
When the OC command is received, the plotter is ready to output the following three values in ASCII code.

X,Y,P [TERM]

X and Y are the coordinate values of plotter coordinates or user coordinates. P indicates the pen condition, 0 for a pen up and 1 for a pen down condition. [TERM] is an output terminator for the RS-232C interface. For details, refer to "5.4 Device Control Command **ESC.M**" in Chapter 5.
When being scaled by the IP and SC commands, X and Y are user coordinates between −32768.0000 and 32767.4999.
Unlike the OA command ,this is the theoretical pen position.Therefore a position outside the drawing area will be output.
Before using the command in an actual program, open a file by the OPEN statement from the computer.

●EXAMPLE

```
10 ' *** "OC" COMMAND ***
20 OPEN "COM1:9600,N,8,1" AS #1
30 PRINT #1,"OC;"
40 INPUT #1,X,Y,P
50 PRINT X,Y,P
```

OD | Output Digitized

(For serial connection only)

●FORMAT
OD [terminator]

●EXPLANATION
When the OD command is received, the plotter is ready to output the X and Y coordinates of the digitized point and the pen condition in the following ASCII form.

X,Y,P [TERM]

X and Y are the integer values of plotter coordinates. P indicates the pen condition, 0 for a pen up and 1 for a pen down condition. [TERM] is an output terminator for the RS-232C interface. For details, refer to "5.4 Device control command **ESC.M**" in Chapter 5.
When the OD command is received, bit 2 of the status byte is cleared. Before using the command in an actual program, execute the OPEN statement by direct command from the computer to open a file. For details, refer to "3.8 Digitize Commands" in Chapter 3.

●EXAMPLE

```
10 ' *** "OD" COMMAND ***
20 OPEN "COM1:9600,N,8,1" AS #1
30 PRINT #1,"DP;"
40 PRINT "Press ENTER key, then press RETURN key."
50 INPUT A
60 PRINT #1,"OD;"
70 INPUT #1,X,Y,P
80 PRINT "X =";X;"  Y =";Y;"  UD/ =";P
90 PRINT #1,"DC;"
```

Note: The digitize command is only effective with a serial connection. If this command is used with a parallel connection, the computer will be unable to receive the data output by the plotter and may not execute any succeeding commands. If this should happen, switch the plotter power OFF and ON once to return to the initial condition.

OE — Output Error

(For serial connection only)

●FORMAT

OE [terminator]

●EXPLANATION

When the OE command is received, the plotter is ready to output an error code in the following ASCII code.

Error code [TERM]

[TERM] is an output terminator for the RS-232C interface. For details, refer to "5.4 Device Control Command **ESC.M**" in Chapter 5.

When the output is completed, bit 5 of the plotter status byte is cleared and the error indicator goes out.

The error codes are defined in Table OE-1.

Bit value	Error No.	Meaning
0	0	No error
1	1	Unrecognizable command issued
2	2	Wrong number of parameters
4	3	Unusable parameter
8	4	Unused
16	5	Unusable character set designated
32	6	Coordinate overflow
64	7	Unused
128	8	Unused

Table OE-1

The OE command is useful for debugging.
Before using the command in an actual program, execute the OPEN statement by direct command from the computer to open a file.

●EXAMPLE

```
10 ' *** "OE" COMMAND ***
20 OPEN "COM1:9600,N,8,1" AS #1
30 PRINT #1,"OE;"
40 INPUT #1,E
50 PRINT "RD-GL1 ERROR CODE :";E
```

OF | Output Factors

(For serial connection only)

●FORMAT
OF [terminator]

●EXPLANATION
The plotter always outputs the following values.

40,40 [TERM]

It indicates that 40 plotter units per 1mm exist on both the X axis and the Y axis.
[TERM] is the output terminator for the RS-232C interface. For details, refer to "5.4 Device Control Command ESC.M" in Chapter 5.

●EXAMPLE

```
10 ' *** "OF" COMMAND ***
20 OPEN "COM1:9600,N,8,1" AS #1
30 PRINT #1,"OF;"
40 INPUT #1,UX,UY
50 PRINT "X-factor =";UX;"  Y-factor =";UY
```

OH | Output Hard Clip

(For serial connection only)

●FORMAT
OH [terminator]

●EXPLANATION
When the OH command is received, the plotter outputs the LL and UR coordinates in integer plotter units.

XLL,YLL,XUR,YUR [TERM]

For negative coordinates, the minus symbols are output, but initial zeros and the plus symbols are omitted by the plotter.

The hard clip limits determine the maximum plotting area. The IW command for setting the plotting area, as described above, can further limit the plotting area by establishing a window at the desired location within the maximum plotting area.
By using the IW command, the output from the OH command is not influenced. [TERM] is the output terminator for the RS-232C interface. For details, refer to "5.4 Device Control Command ESC.M" in Chapter 5.

●EXAMPLE

```
10 ' *** "OH" COMMAND ***
20 OPEN "COM1:9600,N,8,1" AS #1
30 PRINT #1,"OH;"
40 INPUT #1,XLL,YLL,XUR,YUR
50 PRINT "Lower Left  = (";XLL;",";YLL;")"
60 PRINT "Upper Right = (";XUR;",";YUR;")"
```

OI　Output Identification

(For serial connection only)

●FORMAT
OI [terminator]

●EXPLANATION
By using this command, the model name of the plotter currently connected to the computer can be known by the computer. Before this command is actually used in a program, it is necessary to open an RS-232C file on the computer with the OPEN command.
The DXY-1000 series outputs in ASCII code as follows.

Model name	Output
DXY-1100	DXY-1100
DXY-1200	DXY-1200
DXY-1300	DXY-1300

Table OI-1

This command is designed to give the model name of an our brand of plotter, and therefore these results will differ from those of the OI command in other HP-GL™ plotters.

●EXAMPLE

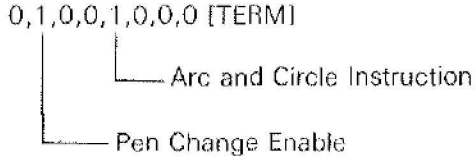
```
10 ' *** "OI" COMMAND ***
20 OPEN "COM1:9600,N,8,1" AS #1
30 PRINT #1,"OI;"
40 INPUT #1,ID$
50 PRINT "The model name : ";ID$
```

OO Output Options

(For serial connection only)

●FORMAT
OO [terminator]

●EXPLANATION
In this command, the following 8 integers, separated by commas, are output to the computer.



[TERM] is the output terminator for the RS-232C interface. For details, refer to "5.4 Device Control Command **ESC.M**" in Chapter 5.

●EXAMPLE

```
10 ' *** "OO" COMMAND ***
20 OPEN "COM1:9600,N,8,1" AS #1
30 PRINT #1,"OO;"
40 INPUT #1,O1,O2,O3,O4,O5,O6,O7,O8
50 PRINT "Option parameter :";O1;O2;O3;O4;O5;O6;O7;O8
```

OP Output P1 and P2

(For serial connection only)

●FORMAT
OP [terminator]

●EXPLANATION
When the plotter receives the OP command, it outputs the following four coordinates in ASCII code.

P1x,P1y,P2x,P2y [TERM]

P1x, P1y, P2x and P2y indicate the integer values of plotter coordinates. [TERM] is an output terminator for the RS-232C interface. For details, refer to "5.4 Device Control Command **ESC.M**" in Chapter 5. Since the OP command only allows the coordinate values to be output, it is necessary to enter the external input command for your computer after the OP command so that the values are acquired by the computer.
For example,

INPUT #1,A,B,C,D

will assign the values of P1x, P1y, P2x and P2y to variables A, B, C and D respectively. When the output is completed, bit 1 of the output status byte is cleared. This command gives you the coordinates of P1 and P2, which were set by the panel keys, and is therefore useful when setting the window within the P1, P2 area or converting between user coordinates and plotter coordinates.

●EXAMPLE

```
10 ' *** "OP" COMMAND ***
20 OPEN "COM1:9600,N,8,1" AS #1
30 PRINT #1,"OP;"
40 INPUT #1,P1X,P1Y,P2X,P2Y
50 PRINT "P1 = (";P1X;",";P1Y;")"
60 PRINT "P2 = (";P2X;",";P2Y;")"
```

OS Output Status

(For serial connection only)

●FORMAT

OS [terminator]

●EXPLANATION

The OS command is used for debugging operations and digitizing applications. No parameter is used with the command. When the OS command is received, the plotter converts an 8-bit status byte value to a decimal value between 0 and 255, and is ready to output it in the following ASCII code value. [TERM] is an output terminator for the RS-232C interface. For details, refer to "5.4 Device Control Command **ESC.**M" in Chapter 5.

Decimal value of status byte [TERM]

Individual bits of the status byte are defined as follows.

Bit value	Bit position	Meaning
1	0	Pen down
2	1	P1 or P2 is changed (cleared by "OP")
4	2	Digitized point can be output by the OD command (cleared by "OD")
8	3	Initialized (cleared by "OS")
16	4	Ready to receive data (always 0)
32	5	There is an error (cleared by "OE")
64	6	Unused (always 0)
128	7	Unused (always 0)

Table OS-1

After power ON, the status byte is 24 in decimal.
This is because bit 3 and bit 4 (initialized and ready to receive data) of the status byte are set, thus the sum of 8 and 16 is 24.

●EXAMPLE

```
10 ' *** "OS" COMMAND ***
20 OPEN "COM1:9600,N,8,1" AS #1
30 PRINT #1,"OS;"
40 INPUT #1,S
50 PRINT "The value of status byte =";S
```

OW	Output Window

(For serial connection only)

●FORMAT
OW [terminator]

●EXPLANATION
This command is used with no parameter. When the plotter receives the command, it outputs the plotter coordinates of the lower left corner and upper right corner of the window in ASCII code.
The order of the outputs is as follows.

X1 lower left, Y1 lower left, X2 upper right, Y2 upper right [TERM]

[TERM] is an output terminator for the RS-232C interface. For details, refer to "5.4 Device Control Command ESC.M" in Chapter 5. To learn the window size, execute the OW command and read the values by computer.

●EXAMPLE

```
10 ' *** "OW" COMMAND ***
20 OPEN "COM1:9600,N,8,1" AS #1
30 PRINT #1,"OW;"
40 INPUT #1,XLL,YLL,XUR,YUR
50 PRINT "Lower Left  = (";XLL;",";YLL;")"
60 PRINT "Upper Right = (";XUR;",";YUR;")"
```

PA	Plot Absolute

●FORMAT
PA X1,Y1[,X2,Y2,···) [terminator]
PA [terminator]

●PARAMETER RANGE
−32768.0000 to +32767.4999

●EXPLANATION

The PA command with no parameters sets the absolute coordinate system. This causes the parameters of subsequent PD and/or PU commands to be expressed as absolute coordinates. The PA command with parameters sets absolute coordinates and, at the same time, moves the pen to the point designated by the X, Y coordinates. The pen remains in the condition that existed before receiving the PA command. Thus, in a pen-up condition, the pen only moves but draws nothing while, in a pen down condition, it draws.

Any number of X and Y parameter pairs can be specifid, but if an odd number of parameters are used, every two parameters from the start will be regarded as an X,Y parameter set to plot and the last single parameter will cause an error.

The PA command is used in combination with the pen control commands PU and PD as shown in the example below.

●EXAMPLE

```
100 ' *** SCALE OFF PLOTTER UNITS ***
110 LPRINT "IN;SP1;"
120 LPRINT "PA3000,1500;PD1000,1500,1000,3500,3000,3500
,3000,1500;PU3500,1500;"
130 LPRINT "PA;PD5500,1500,5500,3500,3500,3500,3500,1500
;PU;"
140 END
```

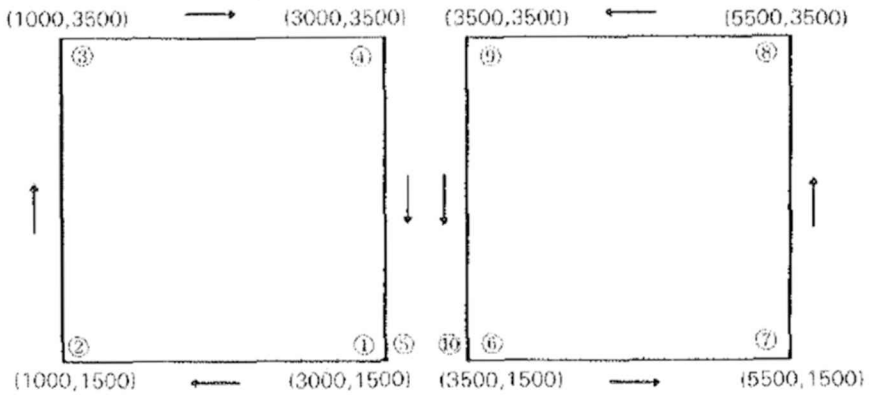


Fig. PA-1

```
150 ' *** SCALE ON USER UNITS ***
160 LPRINT "IN;SP1;"
170 LPRINT "SC0,100,0,100;"
180 LPRINT "PA30,15;PD0,15,0,35,30,35,30,15;PU35,15;"
190 LPRINT "PA;PD65,15,65,35,35,35,35,15;PU;"
200 END
```

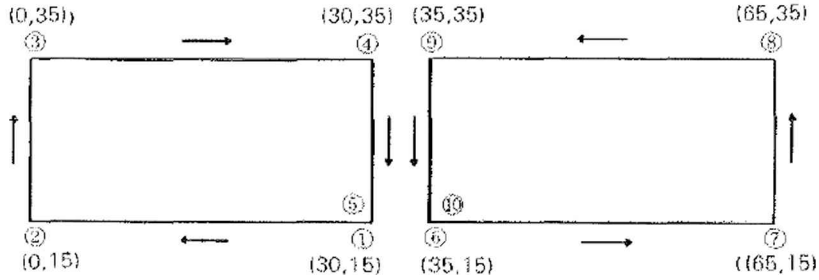


Fig. PA-2

PU and PD	Pen UP/Down

●FORMAT
PU [terminator]
PD [terminator]
PU X1,Y1 (,X2,Y2, ···) [terminator]
PD X1,Y1 (,X2,Y2, ···) [terminator]

●PARAMETER RANGE
−32768.0000 to +32767.4999

●EXPLANATION
Without parameters, the PU, PD commands perform only pen-up or pen-down movement. With parameters, they move the pen to the position specified by the parameters. But the location specified by the parameters will differ in absolute coordinates and in relative coordinates. Inserting the PA command before the parameter will set the position in absoulte coordinates, while inserting the PR command will set the position in relative coordinates.
If the power is turned ON or the standard settings initialized with the DF command or the IN command, the position will be set in absolute coordinates. Therefore, when using the PU and PD commands directly without inputting the PA command or PR command, the parameter considers the specified values to be absolute coordinates.
If a point is designated outside the window, the pen will move to the boundary of the window and then enter pen-up status. A pair of (X,Y) parameters makes one coordinate point, and any number of these points can be used in a sequence. If the total number of parameters is odd, however, the pen movement will follow the sequence of points until the last incomplete coordinate point with the odd parameter and then cause and error. (Even if an error occurs, any subsequent commands will be accurately executed.)

●EXAMPLE

```
10 ' *** "PU & PD" COMMAND ***
20 OPEN "LPT1:" AS #1
30 PRINT #1,"IN;SP1;"
40 PRINT #1,"PU2000,1000;PD2000,3000;"
50 PRINT #1,"PU1000,2000;PD3000,2000;"
60 PRINT #1,"SP0"
```

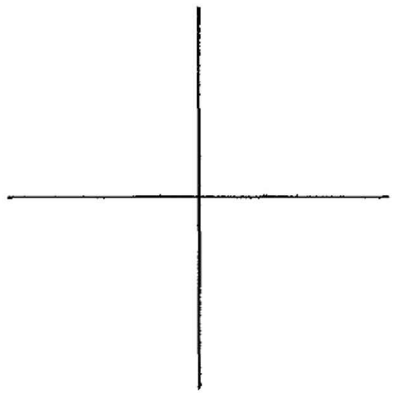


Fig. PUPD-1

PR	Plot Relative

●FORMAT
PR ΔX1,ΔY1 (,ΔX2,ΔY2,···) [terminator]
PR [terminator]

●PARAMETER RANGE
−32768.0000 to +32767.4999

●EXPLANATION
The PR command without parameters is used to set a relative coordinate system. This specifies the parameters of subsequent PD and/or PU commands in relative coordinates. The PR command with parameters sets relative coordinates and, at the same time, moves the pen a distance specified by the parameter. The new position then becomes the point of origin for the next movement.
If an odd number of parameters are used, every two parameters from the start will be regarded as a parameter set and the last single parameter will cause an error.
Switching ON the power or executing either the IN or the DF command is the same as executing the PA command. Therefore, it is always necessary to execute the PR command to set the X and Y values to relative coordinates. The example shown below uses the PR command to draw a square identical to the one drawn in example (1) of the PA command. Each point is specified with ΔX and ΔY in the relative coordinate system.
Compare them with the absolute coordinate values in ( ).

●EXAMPLE

```
100 ' **** PR COMMAND ****
110 LPRINT "IN;SP1;"
120 LPRINT "PA3000,1500;PD;PR-2000,0,0,2000,2000,0,0,
-2000;PU500,0;"
130 LPRINT "PD2000,0,0,2000,-2000,0,0,-2000;PU;"
140 END
```

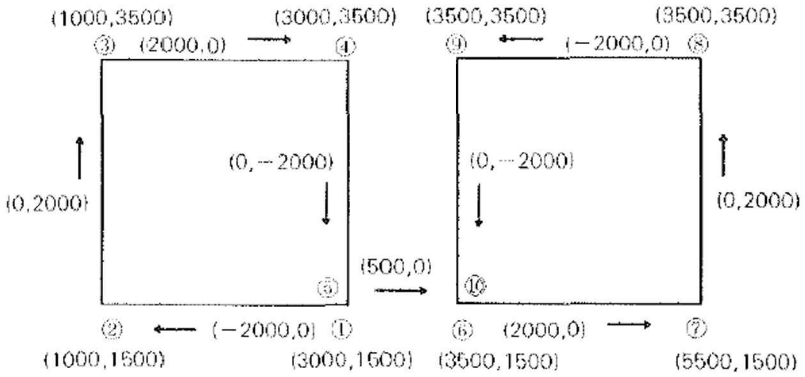


Fig. PR-1

PS	Paper Size

●FORMAT
PS paper size [terminator]

●PARAMETER RANGE
0 to 127

●DEFAULT VALUE
Designated by the DIP switch

●EXPLANATION
Parameter in the range of 0 to 3 select either B or A3, and those in the range of 4 to 127 select either A or A4. The PS command cannot change from ANSI to ISO. Please refer to Appendix A "DIP Switch Setting Table" for details. P1, P2 and the maximum plotting area will be reset according to the paper size. (Refer to the section on the IP command.) If this command is executed, the pen carriage will return the pen to the upper right corner (view position).

●EXAMPLE

```
10 ' *** "PS" COMMAND ***
20 OPEN "LPT1:" AS #1
30 PRINT #1,"PS4;"
```

PT	Pen Thickness

●FORMAT
PT d [terminator]
PT [terminator]

●PARAMETER RANGE
0.1 to 5.0

●DEFAULT VALUE
"PT 0.3;"

●EXPLANATION
Parameters are specified in mm. If the pen thickness is not specified, a value of 0.3mm is set. The PT command is valid only for the pen in use.
When the SP command is executed, the set value is ignored and the pen thickness is set at the default value of 0.3mm until it is set by the next PT command.

●EXAMPLE

```
100 ' *** SHADING SAMPLE ***
110 LPRINT "SP1;FT1,0,0;"
120 LPRINT "PT0.3;"
130 LPRINT "RA1000,1000;"
```

Fig. PT-1

RA	Rectangle Absolute

●FORMAT
RA X,Y [terminator]

●PARAMETER RANGE
−32768.0000 to +32767.4999

●EXPLANATION
Hatches the inside of a rectangle whose diagonal has been specified with the X and Y coordinates. Hatching begins from the current pen position.

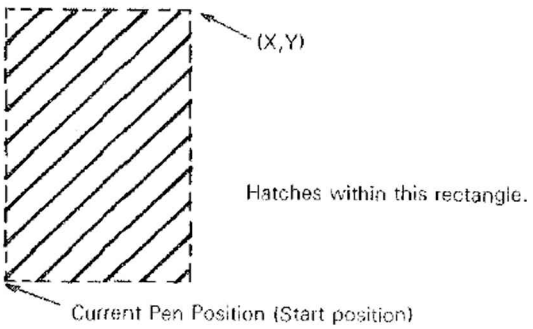


Fig. RA-1

When hatching is completed, the pen returns to the start position.
Hatching is performed in accordance with the current FT and PT command settings (hatching type, shading space, angle).

●EXAMPLE

```
100 ' *** HATCHING SAMPLE ***
110 LPRINT "SP1;FT3,130,45;"
120 LPRINT "PA;PU1000,1000;"
130 LPRINT "RA2000,2000;"
```

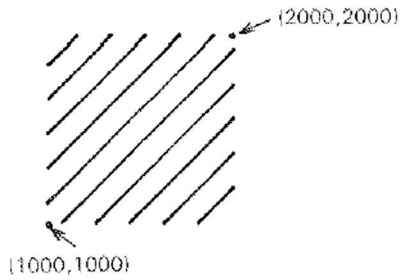


Fig. RA-2

RO	Rotate Coordinate

●FORMAT
RO rotate angle [terminator]
RO [terminator]

●DEFAULT VALUE
"RO 0;"

●EXPLANATION
The RO command without parameters is equal to a parameter of 0. 0 and 90 are the only values that are accepted as parameters. When B/A3 paper size is selected (DIP Switch 1-⑦: OFF), the X and Y axes rotates 90 degrees in a counterclockwise direction, as shown in Fig. RO-1. When A/A4 paper size is selected (DIP Switch 1-⑦: ON), the X and Y axes rotate 90 degrees in a clockwise direction, as shown in Fig. RO-2.
Scaling points P1 and P2 change as the RO command and the IP, IW commands are executed. In Fig. RO-1, RO-2 at ③, if the RO, IP and IW commands without parameters are executed, the plotter enters the default status again.
The IN command can cause the plotter to enter the default status ① from the status in ②, ③, but the DF command cannot.
Pressing the ENTER key on the control panel while pressing the FAST key changes the plotter from ① to ③ in Fig. RO-1, RO-2.

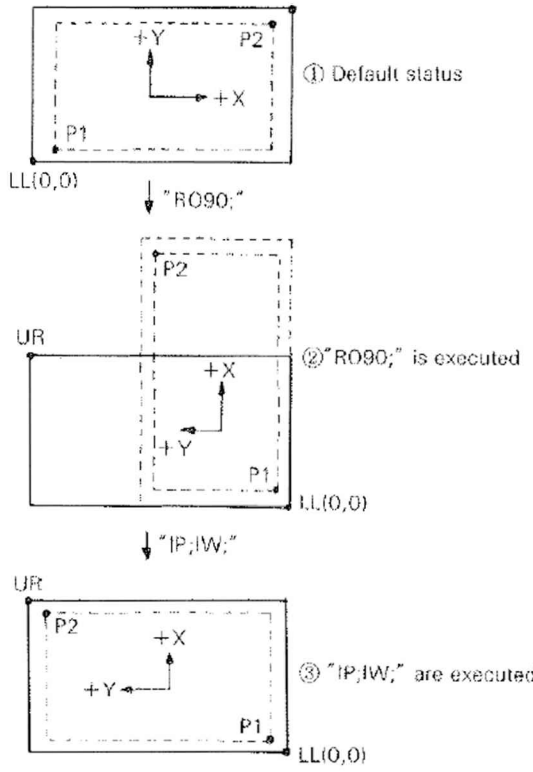


Fig. RO-1 A3/B size

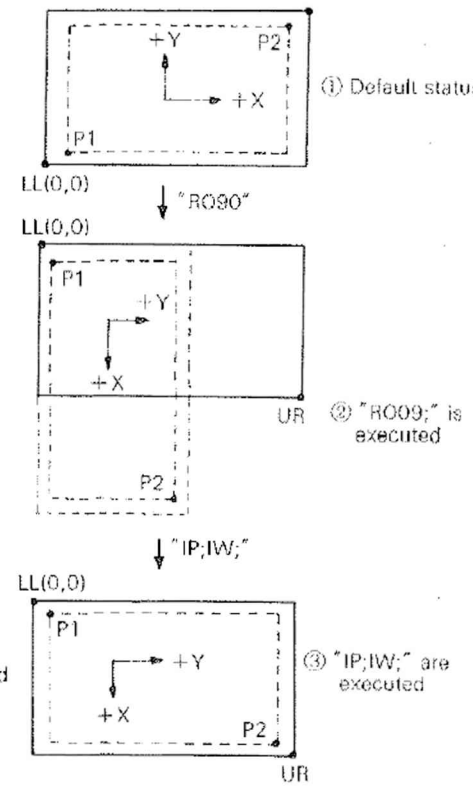


Fig. RO-2 A4/A size

Also, the coordinate values of P1 and P2, after rotation of the axes, will depend upon the paper and standard size set by DIP switches 1-⑦, 1-⑧, and these values are shown in the following table.

Paper size	P1x,P1y	P2x,p2y
A3(ISO)	607,797	10607,15987
A4(ISO)	0,610	7200,10810
B(ANSI)	283,934	10283,16134
A(ANSI)	154,244	7354,10244

Table RO-1

Note: Even if the coordinate axes are rotated by the RO command, the XY coordinate display will indicate the same values before the coordinate axes were rotated. (In case of DXY-1300/1200)

●EXAMPLE

```
10 ' *** "RO" COMMAND ***
20 OPEN "LPT1:" AS #1
30 PRINT #1,"IN;SP1;"
40 PRINT #1,"RO0;"
50 PRINT #1,"PA1000,1000;LBROTATE 0";CHR$(3)
60 PRINT #1,"RO90;"
70 PRINT #1,"PA1000,1000;LBROTATE 90";CHR$(3)
80 PRINT #1,"SP0;"
```

ROTATE 90

ROTATE 0

Fig. RO-3

RR	Rectangle Relative

●FORMAT
RR ΔX,ΔY [terminator]

●PARAMETER RANGE
−32768.0000 to +32767.4999

●EXPLANATION
Hatches a rectangle starting from the current pen position is on angle to the position determined by the relative distance in the X-axis direction and the relative distance in the Y-axis direction.

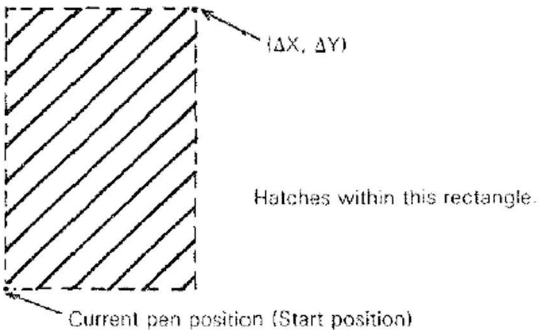


Fig. RR-1

Hatching is performed in accordance with the current FT and PT command settings (hatching type, shading space, angle).
When hatching(shading) is completed, the pen will return to the starting position.

●EXAMPLE

```
100 ' *** HATCHING SAMPLE(2) ***
110 LPRINT "SP1;FT4,100,90;"
120 LPRINT "PA;PU2000,2000;"
130 LPRINT "RR1000,1000;"
```

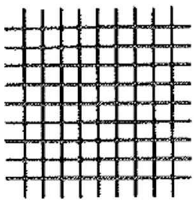


Fig. RR-2

SA	Select Alternate

●FORMAT
SA [terminator]

●EXPLANATION
After execution of the SA command, a character set designated by the CA command is used for printing. This is effective until the standard character set is selected by the SS command or by [SI]CHR$(15), or by using the DF or IN command to reset the plotter. In print mode, the alternate character set can be selected by [SO]CHR$(14).
This command requires no parameter. For its relation to the CS, CA and SS commands, refer to "3.6.2 Character Sets" in Chapter 3.

●EXAMPLE

```
10 ' *** "SA" COMMAND ***
20 OPEN "LPT1:" AS #1
30 PRINT #1,"IN;SP1;PA1000,1000;"
40 PRINT #1,"CS0;CA7;"
50 PRINT #1,"SS;"
60 PRINT #1,"LBy=";CHR$(3)
70 PRINT #1,"SA;"
80 PRINT #1,"LB";CHR$(120);CHR$(3)
90 PRINT #1,"SS;
100 PRINT #1,"LBx+1";CHR$(3)
110 PRINT #1,"SP0;"
```

$$y = \frac{1}{2}x + 1$$

Fig. SA-1

SC	Scale

●FORMAT
SC Xmin,Xmax,Ymin,Ymax [terminator]
SC [terminator]

●PARAMETER RANGE
−32768.0000 to +32767.4999

●DEFAULT VALUE
Depends on the DIP switch setting of the paper size mode.

●EXPLANATION
The SC command with parameters sets the user coordinates of P1 to Xmin and Ymin and P2 to Xmax and Ymax. Each parameter must be a real number between −32768.0000 and 32767.4999. User coordinates once set are effective until they are rescaled by another SC command or returned to plotter coordinates by the SC command with no parameters. While the command is active, all plot command parameters are regarded as user coordinates. The SC command without parameters specifies all subsequent plotting commonds in plotter coordinates and returns the plotter to an unscaled condition. For details, refer to "3.3.1 Scaling" in Chapter 3.

●EXAMPLE

```
10 ' *** "SC" COMMAND ***
20 OPEN "LPT1:" AS #1
30 PRINT #1,"IN;SP1;PA0,0;"
40 PRINT #1,"IP0,0,1000,1000;SC0,100,0,100;"
50 PRINT #1,"EA100,100;"
60 PRINT #1,"IP0,0,3000,2000,SC0,100,0,100;"
70 PRINT #1,"EA100,100;"
80 PRINT #1,"SP0;"
```

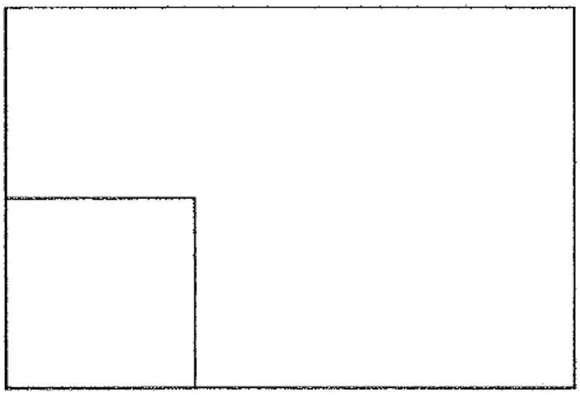


Fig. SC-1

SI	Absolute Character Size

●FORMAT
SI character width, height [terminator]
SI [terminator]

●PARAMETER RANGE
−128.0000 to +127.9999 (cm)

●DEFAULT VALUE
"SI 0.29,0.38;" (B/A3)
"SI 0.19,0.27;" (A/A4)

●EXPLANATION
The SI command specifies the absolute character size by two parameters, character width and height. A character size specified by the SI command is unchanged by reduction or enlargement using the IP, SC, or IW command or by manual control. The SI command without parameters sets the default status. A single parameter or 3 or more parameters will cause an error and the character size will be unchanged.

●EXAMPLE

```
10 ' *** "SI" COMMAND ***
20 OPEN "LPT1:" AS #1
30 PRINT #1,"IN;SP1;PA1000,1000;"
40 PRINT #1,"SI0.3,0.4;"
50 PRINT #1,"LB0.3x0.4cm";CHR$(3)
60 PRINT #1,"SI0.5,1;"
70 PRINT #1,"LB0.5x1.0cm";CHR$(3)
80 PRINT #1,"SP0;"
```

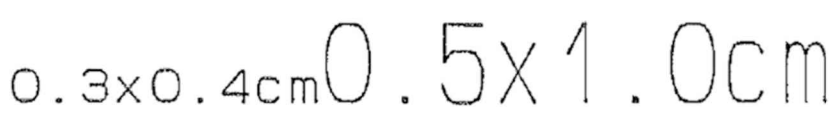


Fig. SI-1

SL	Slant

●FORMAT
SL tanθ [terminator]
SL [terminator]

●PARAMETER RANGE
−128.0000 to +127.9999

●DEFAULT VALUE
"SL 0;"

●RELATED COMMANDS
IN, DF

●EXPLANATION
The parameter tanθ specifies on angle relative to a vertical line, as shown in Fig. SI-1. If two or more parameters are used, all parameters other than the first one will be ignored. The SL command without parameters defaults to slant condition. The parameter range is from −128.0000 to +127.4999. However, for easy reading, it is advisable to use a parameter within ±0.4 for default size characters or ±0.8 for enlarged. The SL command remains in effect until IN, DF or a new SL command is received.

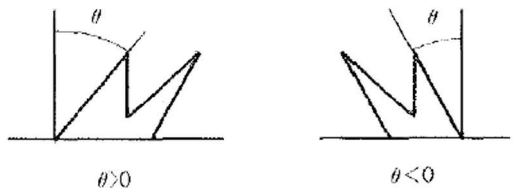


Fig. SL-1

●EXAMPLE

```
10 ' *** "SL" COMMAND ***
20 OPEN "LPT1:" AS #1
30 PRINT #1,"IN;SP1;PA1000,1000;"
40 PRINT #1,"SL0;"
50 PRINT #1,"LBSL0";CHR$(3)
60 PRINT #1,"SL0.4;"
70 PRINT #1,"LBSL0.4";CHR$(3)
80 PRINT #1,"SL0.8;"
90 PRINT #1,"LBSL0.8";CHR$(3)
100 PRINT #1,"SP0;"
```

SL0*SL0.4SL0.8*

Fig. SL-2

SM	Symbol Mode

●FORMAT

SM character or symbol [terminator]
SM [terminator]

●DEFAULT VALUE

"SM;" (no symbol mode)

●RELATED COMMANDS

SI, SR, SL, DI, DR

●EXPLANATION

The parameter is limited to a single, printable character or symbol. After a character or symbol is designated by the SM command, it is printed centered on a point specified by the PA or PR command. Once designated, it is effective until another character is designated (symbol mode is not released) or symbol mode is released. Symbol mode is released by the SM command with no parameter.
The IN or DF command also releases the symbol mode.
A designated character is affected by commands that change the size (SI or SR), slant (SL) or direction (DI or DR).
A semicolon [;]CHR$(59) cannot be designated because it is regarded as a terminator. Also, a space or control code cannot be designated.
The example shown below draws characters or symbols at the points of broken lines.

●EXAMPLE

```
100 ' **** "SM" COMMAND ****
110 LPRINT "IN;SP1;PA0,0;"
120 LPRINT "PD0,3000,3000,3000,3000,0,0,0;PU;"
130 FOR I=1 TO 3
140 READ S$
150 LPRINT "SM";S$;";"
160 X=500
170 FOR L=1 TO 4
180 READ Y
190 LPRINT "PA";X;",";Y;";PD;"
200 X=X+500
210 NEXT L
220 LPRINT "PU;"
230 NEXT I
240 LPRINT "SM;PA0,0;"
250 END
260 DATA *,500,1300,2000,2700
270 DATA R,1500,1700,1300,1000
280 DATA G,2800,2000,1000,400
```

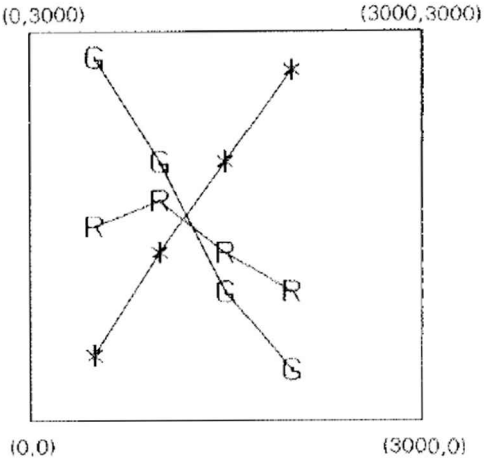


Fig. SM−1

SP	Select Pen

●FORMAT
SP pen number [terminator]
SP [terminator]

●PARAMETER RANGE
0 to 8

●DEFAULT VALUE
"SP 0;"

●EXPLANATION
Selects one of No.1 to No.8 pens according to the parameter. The SP command with no parameter or 0 returns the pen to the pen stock and moves to the view position. After a pen is taken up, the system returns to the position is occupied before executing the SP command. If the same pen number as the one currently in pen carriage is designated, the pen carriage will not move.

●EXAMPLE

```
10 ' *** "SP" COMMAND ***
20 OPEN "LPT1:" AS #1
30 PRINT #1,"IN;"
40 FOR I=1 TO 8
50   PRINT #1,"SP";I;";"
60   PRINT #1,"PA;PU1000,";I*300;";"
65   PRINT #1,"PD;PR1000,0;"
70   PRINT #1,"LBPEN No.";I;CHR$(3)
80 NEXT I
90 PRINT #1,"SP0;"
```

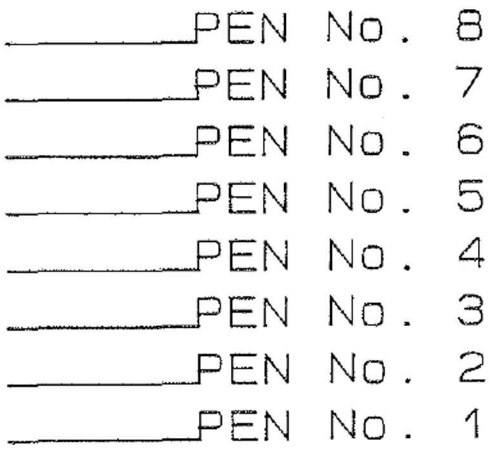


Fig. SP-1

SR	Relative Character Size

●FORMAT

SR character width, height [terminator]
SR [terminator]

●PARAMETER RANGE

−128.0000 to +127.9999 (%)

●DEFAULT VALUE

"SR 0.75,1.5;"

●RELATED COMMANDS

IP, SC, IW

●EXPLANATION

The SR command specifies a relative character size that can vary with the distance between P1 and P2. The command without parameters sets the default values. A single parameter or 3 or more parameters will cause an error and the command will not be executed.

$$\text{Character width} = (P2x - P1x) \times \frac{\text{width parameter}}{100}$$

$$\text{Character height} = (P2y - P1y) \times \frac{\text{height parameter}}{100}$$

●EXAMPLE

```
10 ' *** "SR" COMMAND ***
20 OPEN "LPT1:" AS #1
30 PRINT #1,"IN;SP1;PA1000,1000;"
40 PRINT #1,"SR0.75,1.5;"
50 PRINT #1,"LB0.7x1.5";CHR$(3)
60 PRINT #1,"SR2,2;"
70 PRINT #1,"LB2x2";CHR$(3)
80 PRINT #1,"SP0;"
```

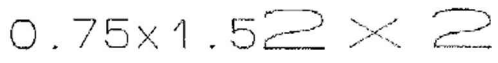


Fig. SR-1

SS	Select Standard

●FORMAT
SS [terminator]

●EXPLANATION
After execution of the SS command, a character set designated by the CS command is used for printing. This is effective until an alternate character set is selected by the SA command or [SO]CHR$(14), or by resetting the plotter with the DF or IN command.
In print mode, the standard character set can be selected by [SI]CHR$(15). This allows a text composed of English and German to be printed using only a single LB command, eliminating the need of dividing the LB command to execute the SS command. This command requires no parameter. For its relation to the CS, CA and SA commands, refer to "3.6.2 Character Sets" in Chapter 3.

●EXAMPLE

```
10 ' *** "SS" COMMAND ***
20 OPEN "LPT1:" AS #1
30 PRINT #1,"IN;SP1;PA1000,1000;"
40 PRINT #1,"CS1;"
50 PRINT #1,"SS;"
60 PRINT #1,"LBtan(¢/3)=\3";CHR$(3)
70 PRINT #1,"SP0;"
```

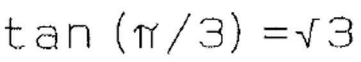


Fig. SS-1

TL	Tick Length

●FORMAT
TL tick length in positive direction [,tick length in negative direction) [terminator]
TL [terminator]

●PARAMETER RANGE
−128.0000 to +127.9999(%)

●DEFAULT VALUE
"TL 0.5,0.5;"

●EXPLANATION

Positive tick refers to the up direction on the X axis and the right direction on the Y axis, and negative tick refers to the down direction on the X axis and the left direction on the Y axis.

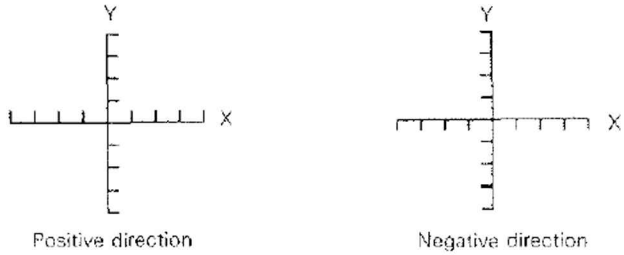


Fig. TL-1

The tick length parameter value used with the XT command is a percentage of P2y−P1y, and that with the YT command a percentage of P2x−P1x. The parameter range is from −128.0000 to +127.9999. 0 designates no tick.

A parameter of 100 draws a tick between points P1 and P2 in the X and Y directions. Parameter 100 is used to create devisions within a table rather to draw scale ticks.

Tick length is a portion of the length in the X and Y directions determined by points P1 and P2. Therefore, note that the length of X tick is different from that of Y tick when an area set by points P1 and P2 is not a square. When the plotter is initialized or the TL command with no parameter is executed, it is automatically set to 0.5% of the length between point P1 and P2 in the X and Y directions. The tick length in the negative direction is set to 0 if it is not specified.

The TL command is effective until another TL command is executed or the IN or DF command is executed.

Use a positive parameter in principle, because a negative parameter specifies a tick length in reverse direction.

A parameter out of the specified range will cause an error when the XT or YT command is executed.

●EXAMPLE

```
10 ' *** "TL" COMMAND ***
20 OPEN "LPT1:" AS #1
30 PRINT #1,"IN;SP1;PA1000,1000;PD;"
40 FOR I=1 TO 10
50   PRINT #1,"TL2,0;XT;PR40,0;"
60   PRINT #1,"TL1,0;"
70   FOR J=1 TO 4
80     PRINT #1,"XT;PR40,0;"
90   NEXT J
100 NEXT I
110 PRINT #1,"TL2,0;XT;SP;"
```

Fig. TL-2

UC	User Defined Character

●FORMAT

UC (pen control value,) ΔX1,ΔY1, (pen control value,) ··· (ΔXn,ΔYn) ··· [terminator]
UC [terminator]

●PARAMETER RANGE

−128.0000 to +127.9999

●EXPLANATION

The UC command uses three types of parameters: pen control value, X differential, and Y differential.

The pen control value designates a pen up/down condition, −99 or less for a pen up, and 99 or more for a pen down condition. It is advisable to use −99 and 99. The pen always goes up when the plotter receives the UC command and, therefore, a pen down parameter should be placed in the UC command in order to make a point. After the UC command is completed, the pen goes up, moves to the lower left corner of the next right character cell, then returns to the pen condition before the execution of the UC command. The X or Y differential designates a horizontal or vertical pen movement in grid units. The X and Y differentials should be greater than −99 and smaller than 99, and a decimal fraction can be used.

A character cell is divided horizontally into 6 sections and vertically into 16 sections for the purpose of specifying pen movement. (See Fig. UC-1)

An ordinary character is printed within the area surrounded by broken lines, horizontal 4 sections × vertical 8 sections. A character defined within this area has a normal character size. A character defined by the UC command need not be within a character cell. However, since the origin point of a character is shifted only by a character cell after printing, the PA, PR or CP command should be used to move the pen out of the defined area when the character to be printed is not within a single character cell. Otherwise, the next character will overlap the printed character.

See Fig. UC-2 for an example of how to draw an arrow mark with the UC command. The origin point of the character after executing the UC command is (6,0), and the next character will overlap the end of the arrow if the next character is printed as it is. Therefore, "CP1,0;" must be executed to move the origin point to (12,0). A UC command with no parameters moves, the pen to the starting position in the previously generated LB command.

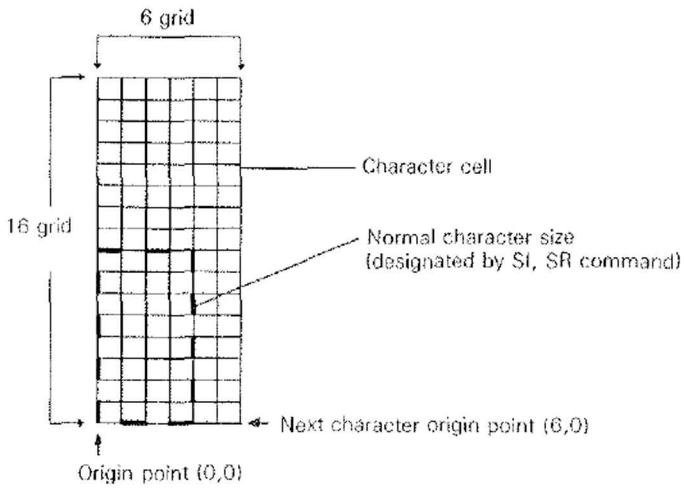
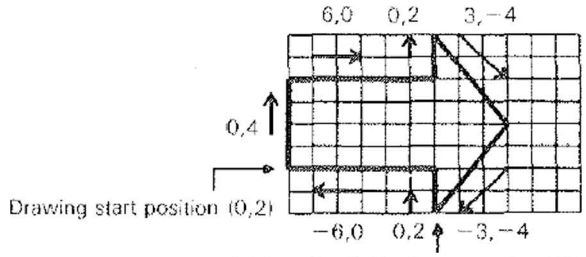


Fig. UC-1



Origin point (6,0) after executing UC command
"UC0,2,99,0,4,6,0,0,2,3,−4,−3,−4,0,2,−6,0;"

Fig. UC-2

●EXAMPLE

```
10 ' *** "UC" COMMAND ***
20 OPEN "LPT1:" AS #1
30 PRINT #1,"IN;SP1;PA3000,2500;"
40 PRINT #1,"LBABC";CHR$(3)
50 PRINT #1,"UC0,2,99,0,4,6,0,0,2,3,-4,-3,-4,0,2,-6,0
   ;CP1,0;"
60 PRINT #1,"LBDEF";CHR$(3)
70 PRINT #1,"SP0;"
```

ABC⇨DEF

Fig. UC-3

VS	Velocity Select

●FORMAT

VS pen speed [terminator]
VS [terminator]

●PARAMETER RANGE

0 to 127.9999

●DEFAULT VALUE

"VS 42;"

●EXPLANATION

The VS command with no parameter sets the pen speed to the initial value, 42cm/sec. The parameter range is 0 to 127.9999. A parameter of less than 1 sets the speed to 1cm/sec, or more than 42 sets to 42cm/sec.

Reducing the pen speed with the VS command will allow the plotter to draw thick lines or clear lines.

Also, the proper pen speed for a given pen can be set with this command. Refer to the following table.

Pen type	Pen speed
Water based fiber tipped pen	42cm/sec.
Thick water based fiber tipped pen for POP art	42cm/sec.
Oil based fiber tipped pen for OHP film	10cm/sec.
Ceramic pen	10cm/sec.
Ink pen	20cm/sec.

Table VS-1

●EXAMPLE

```
10 ' *** "VS" COMMAND ***
20 OPEN "LPT1:" AS #1
30 PRINT #1,"IN;SP1;VS10;"
```

WG Shade Wedge

●FORMAT

WG r,θ1,θc (,θd) [terminator]

●PARAMETER RANGE

r	:	Radius	−32768.0000 to +32767.49999
θ1	:	Start angle	−32768.0000° to +32767.49999°
θc	:	Center angle	−32768.0000° to +32767.49999°
θd	:	Resolution	−32768.0000° to +32767.49999° (default value: 5°)

●RELATED COMMANDS

FT, PT, EW

●EXPLANATION

The hatcting type, spacing, and angle are the same as those specified with the FT and PT commands. Since the base point differs with the sign of the radius parameter, care is required with its specification. The angle relative to the base point differs according to the sign of the start and center angle parameters.

The drawing direction changes in accordance with the sign of the parameter.

The resolution specifies the smoothness of the circular arc or the wedge. The parameter is specified as an angle(°). The total number of chords par arc is limited to 90. For example, when θc=360° and θd=0°, the resolution θd is set to 4°. If the resolution is not specified, 5° is set. θd is changed to an integer to divide θc equally. The smoothest circles are drawn when θd is specified with 0°.

The pen returns to the start position after drawing is completed.

The drawing direction changes in accordance with the sign of the parameter.

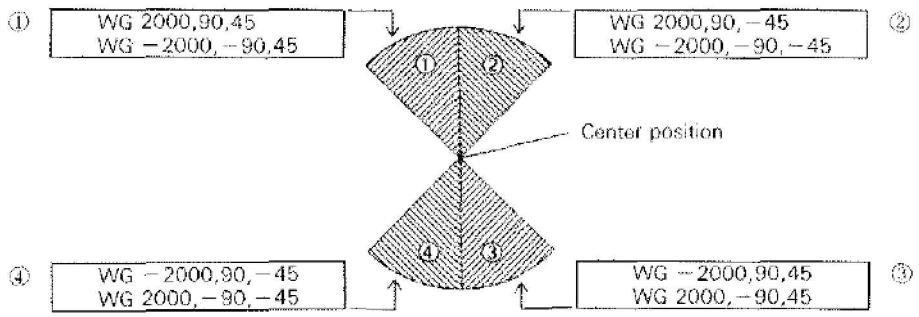


Fig. WG-1

●EXAMPLE

```
100 ' *** Wedge Hatching ***
110 LPRINT "SP1;PA;PU2000,5000;"
120 LPRINT "FT3,40,0;"
130 LPRINT "WG2000,90,45;"
140 LPRINT "FT3,40,45;"
150 LPRINT "WG2000,90,-45;"
160 LPRINT "FT3,40,90;"
170 LPRINT "WG-2000,90,-45;"
180 LPRINT "FT3,40,135;"
190 LPRINT "WG-2000,90,45;"
```

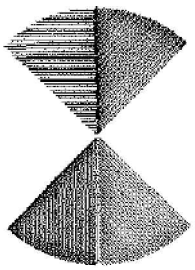


Fig. WG-2

XT and YT	Tick

●FORMAT

XT [termintor]
YT [terminator]

●EXPLANATION

No parameter is required. This command prints a tick based on the current pen position, regardless of pen up/down condition. The tick length can be changed by the TL command. The default value of X axis tick is 0.5% of (P2y−P1y) in both positive and negative directions, and that of Y axis tick is 0.5% of (P2x−P1x).
Examples of the XT command are shown below. In example 1, the tick is drawn while drawing the axis.
In example 2, the axis is drawn, then the tick.

●EXAMPLE

Example 1

```
100 ' *** "XT" COMMAND NO.1 ***
110 LPRINT "IN;SP2;PA200,500;PD;XT;"
120 FOR I=1 TO 10
130 LPRINT "PR200,0;XT;"
140 NEXT I
150 LPRINT "PU;SP0;"
```

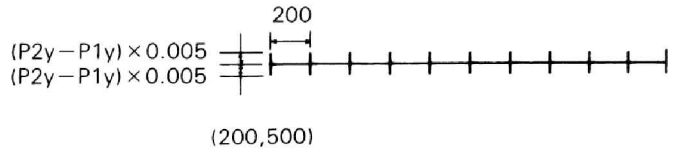


Fig. XTYT-1

Example 2

```
200 ' *** "XT" COMMAND NO.2 ***
210 LPRINT "IN;SP2;PA200,500;PD;"
220 LPRINT "PR2000,0;XT;PU;"
230 FOR I=1 TO 10
240 LPRINT "PR-200,0;XT;"
250 NEXT I
260 LPRINT "SP0;"
```

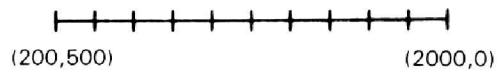


Fig. XTYT-2

CHAPTER 4
ERRORS

The DXY-1000 series indicates errors if it cannot continue to operate properly, if the communication protocol for a Serial Interface has not been properly set, etc. In such case, the DXY-1000 series lights up or blinks the [POWER/ERROR] LED quicklly to show something wrong. Depending on errors, the DXY-1000 series keeps executing incoming commands, but it cannot execute the commands at the time of errors and so does not assure of further drawings.
In such a case, you are required to find what has caused an error and solve them.

4.1 Kinds of Errors

Errors are classified into the following 3 kinds.

①**Command error:**
This error occurs when an incorrect RD-GL I command or and out-of-range parameter has been set.
If you have used a Serial Interface, you can remove errors and know the content of errors by executing the OE command.

②**Device control command error:**
This error occurs when the connection with the computer is a serial connection or when the device contorl command is improper.
You can remove errors and know the content of errors by executing the **[ESC]** command. For more information, see "**ESC**.E" Command of "Device Control Command" in CHAPTER 5.

③**Communication protocol error:**
This error occurs when the setting of the communication protocol for a serial connection is incorrect. If there is a mismatch in the communication protocol (such as the baud rate) between the computer (software) and the plotter connected to it, a communication protocol error will occur.
Set a proper communication protocol reading Appendix A "DIP Switch Setting Table" and the operation manual for the computer (software).

4.2 Judgment of Error

When the connection with the computer is a serial interface connection, the type of error can be determined by the computer.
The following BASIC program will perform and error check and display the error number on the screen. The errors that correspond to these error numbers are listed in the table below.

```
10 ' *** Error Check Program ***
20 OPEN "COM1:9600,N,8,1" AS #1
30 PRINT #1,"OE;"
40 INPUT #1,CE
50 PRINT " COMMAND ERROR ---";CE
```

```
60 PRINT #1,CHR$(27);".E"
70 INPUT #1,IE
80 PRINT "I/O ERROR -------";IE
90 END
```

COMMAND ERROR	MEANING
0	No error
1	Unrecognizable command issued
2	Wrong number of parameters
3	Parameter out of range
4	Unused
5	Unusable character designated
6	Coordinate overflow
7	Unused

I/O ERROR	MEANING
0	No error
10	While an output request is being executed, another command requesting output will not be accepted, and only the first command is valid.
11	A device control command error has occurred.
12	When a device control command parameter is unsuitable, the parameter causing the error is initialized.
13	When a parameter has overflowed.
14	When too many parameters are input, or parameters are not terminated by a ";"
15	When a framing error, parity error, or overrun error has occurred during reception of data.
16	When the input buffer has overflowed. In this case normal drawing operation is impossible.

●List mode

When the list mode is used, the plotter will draw a command or a parameter character string exactly as sent. This is a useful tool to check drawing data or to debug drawing programs. Both parallel and serial connections may be used with this function.
Please refer to the user reference manual "3.1.4 List Mode" in CHAPTER 3 for details.

CHAPTER 5
INFORMATION ABOUT INTERFACES

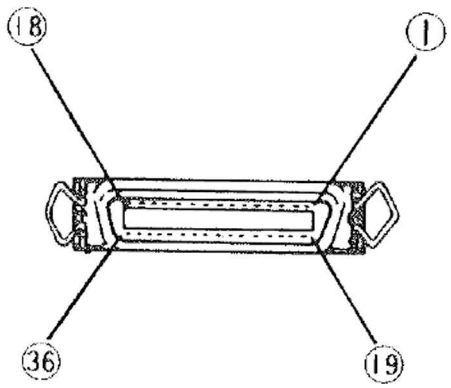
5.1 Parallel (Centronics) Connection

The parallel input connector of the DXY-1000 series complies with the specifications for a Centronics interface and may be used with almost any printer cable or computer. For more information about how to connect the DXY-1000 series to each computer, see the cable list of 5.1 "Parallel Connection (Centronics)".

5.1.1 Parallel Interface Specifications

●Connectors

NC	36	18	HIGH**
HIGH*	35	17	GND
NC	34	16	GND
GND	33	15	NC
HIGH*	32	14	NC
NC	31	13	HIGH*
GND	30	12	GND
	29	11	BUSY
	28	10	$\overline{\text{ACK}}$
HIGH	27	9	D7
GND	26	8	D6
	25	7	D5
	24	6	D4
	23	5	D3
	22	4	D2
	21	3	D1
	20	2	D0
	19	1	$\overline{\text{STROBE}}$



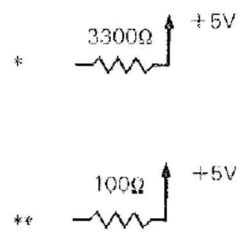


Fig. 5-1

●I/O signal cable

The way each connector inputs and outputs data is shown in Fig. 5-2.

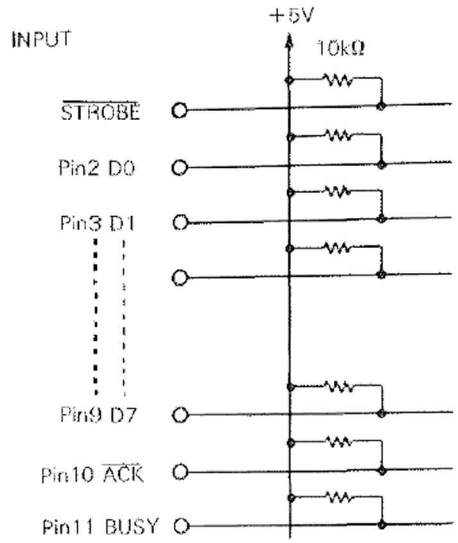


Fig. 5-2

The I/O signal timing chart is shown in Fig. 5-3.

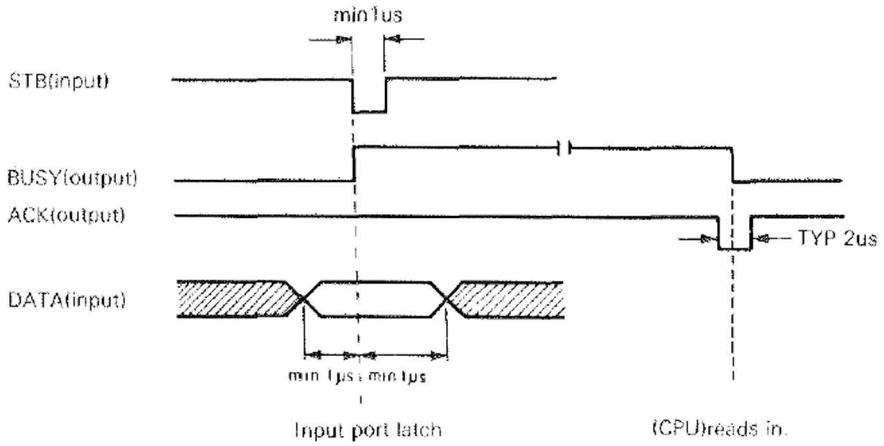


Fig. 5-3

5.2 Serial (RS-232C) Connection

When you select a serial (RS-232C) interface for connecting the DXY-1000 series to a computer, follow the cable list of "Serial Connection (RS-232C)". If you use your computer and interface under different conditions than those described in Chapter 5, refer to the explanation below.
Also, for the handshake of an RS-232C interface, see "5.3 Information About Handshake" in Chapter 5.

5.2.1 Serial Interface Specifications

●Connectors

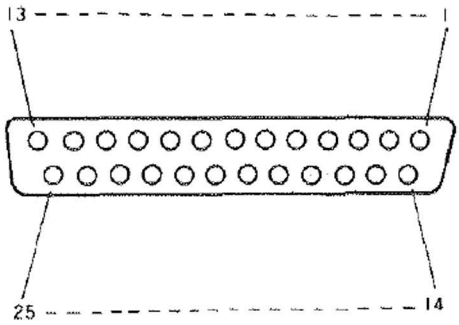
Terminal No.	Signal	Pin connection
1	FG	
2	TXD	
3	RXD	
4	RTS	
5	CTS	
6	DSR	
7	SG	
8	NC	
9	NC	
10	NC	
11	NC	
12	NC	
13	NC	
14	S.TXD	
15	NC	
16	S.RXD	
17	NC	
18	NC	
19	NC	
20	DTR	
21	NC	
22	NC	
23	NC	
24	NC	
25	NC	

Table 5-1

● Signal lines are shown in Table 5-2.

Pin No.	Abbrev.	Description	Plotter side
1	FG	Security line which is normally connected with the computer frame. Connected to the plotter frame.	〈Com〉
2	TXD	Transmit data. Data output from the plotter to the computer. Connected to the receive data line of the computer. SPACE = "0" = +12V MARK = "1" = −12V	〈Output〉
3	RXD	Receive data. Data receive line of the plotter from the computer. Connected to the transmit data line of the computer. SPACE = "0" = +3V to +25V MARK = "1" = −3V to −25V	〈Input〉
4	RTS	Request to send. Output from the plotter to the computer. Always ON (+12v) is output.	〈Output〉
5	CTS	Clear to send. Input from the computer to the plotter. When the signal line is ON (+3V to −25V), the plotter is ready to output data, or when the line is OFF (−3V to −25V), no data will be output. When unconnected, the plotter always operates with ON status.	〈Input〉
6	DSR	Data set ready. Normally this line is connected with a signal line to indicate the ready-to-operate status of a modem. Input from the computer to the plotter. Same as for CTS when unconnected, with no problem for the plotter in normal use.	〈Input〉
7	SG	Signal ground connected with the internal ground line in the plotter.	〈Com〉
14	S.TXD	Data output from the plotter to the computer in Y-connection.	〈Output〉
16	S.RXD	Data receiving line in Y-connection.	〈Input〉
20	DTR	Data terminal ready signal to indicate that the system is ready to communicate As in RTS, with DIP SWI-⑤ set to ON (to serial). When hardwire handshake is enabled by the ESC @, the plotter controls DTR ON (+12V) or DTR OFF (−12V) according to the remaining capacity of the buffer. When hardwire handshake is set to disable by the ESC.@ command, DTR is always +12V. DTR can be connected with CTS or DSR of the computer for handshaking, provided that the computer has a function to monitor the above signal line and stop the data output.	〈Output〉

Table 5-2

5.2.2 Y-Connection (Y-DROP)

When a host computer and a terminal are connected with an RS-232C, the DXY-1000 series can be connected between them. This is called a Y-connection and performs the following functions: it can transmit data from the host computer to the terminal, it can transmit data to the plotter for drawing and it can permit the terminal to monitor the data while drawing is under way.

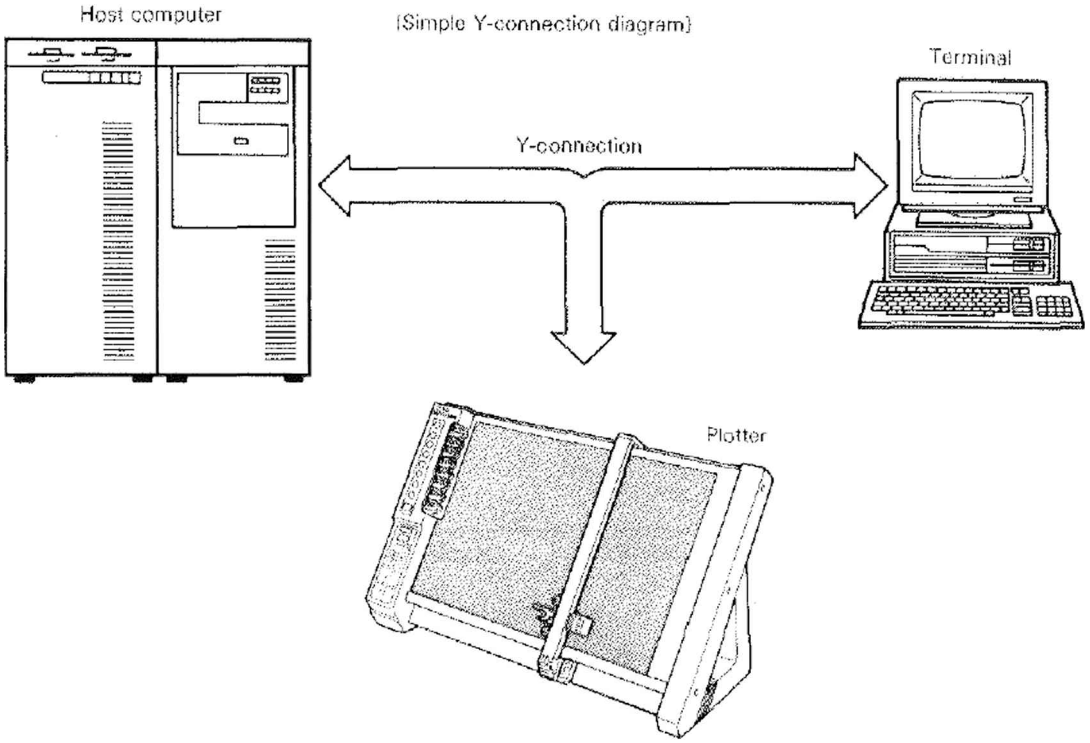


Fig. 5-4

Cables used for the Y-connection are shown in Fig. 5-5.

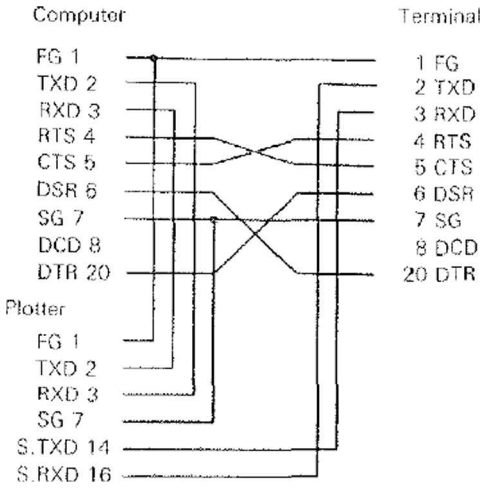


Fig. 5-5

● Y-connection setting

To use the Y-connection, turn ON DIP Switch 2-④ of the DXY-1000 series first and then turn ON the power switch next. In this condition, all the data is transmitted from the host computer to the terminal or vice versa without passing through the I/O buffer. At this time, the DXY-1000 series only transmits the data but does no drawing.

When it receives the ESC.Y or ESC.(command, the DXY-1000 series stores data in the I/O buffer and starts drawing according to the data. Obviously the data being transmitted here must be drawing data, and they can be output to the terminal. The way the drawing data are output to the terminal varies depending on the 2nd bit to 3rd bit of the second parameter of ESC.@ command as shown in Table 5-3. (Monitor mode OFF, monitor mode 1, monitor mode 2).

The way your computer responds to a request of the DXY-1000 series varies depending on whether the request comes from an RD-GL I command or a device control command. In fact, it varies from the 2nd bit to 3rd bit of the second parameter of ESC.@ command as shown in Table 5-3. In this condition, data from the terminal can be sent to the computer. But when the DXY-1000 series is responding to the computer, this response has first priority and the data from the terminal are ignored.

Also, when it receives the ESC.Z or ESC.) command, the DXY-1000 series returns to the same condition as before it received the ESC.Y command or ESC.(command.

		Monitor mode OFF	Monitor mode 1	Monitor mode 2
	2nd parameter of ESC.@ command	ESC. @;0: or ESC. @;4:	ESC.@;8:	ESC.@;12:
	Before receiving ESC.Y or ESC.(, or after receiving ESC.Z or ESC.).	Output all data to a terminal including device control commands. (Output ESC.Y and ESC.(too.)		
	After receiving ESC.Y or ESC.(.	Does not output to a terminal.	Output data other than those of device control commands to a terminal ❶.	Output data, including those of device control commands, to a terminal ❷.
How to output a response to a request by a device control command.		Output data to a host computer.		
How to output a response to a request by a RD-GL I commands.		Output data to a host computer.	Output data to both host computer and terminal.	

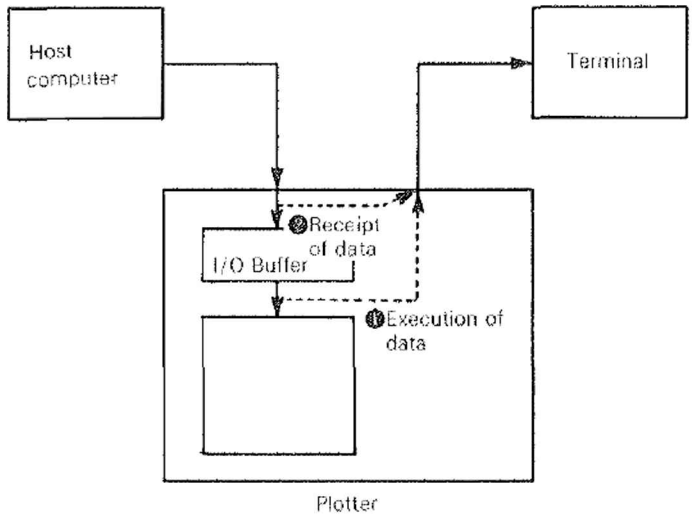


Table 5-3

If, after receiving an **ESC.Y** or **ESC.(** command, a break signal that lowers the RXD terminal (No.3 pin) of the plotter below 150m/sec. Comes from the terminal, the plotter will send this break signal to the computer and then return to the same condition as if it had received an **ESC.Z** or **ESC.)** command.
Remember: Since data go through the internal circuit of the DXY-1000 series to a terminal, you must have turned ON the power of the DXY-1000 series for data communication between the computer and the DXY-1000 series even when you are not using the DXY-1000 series.

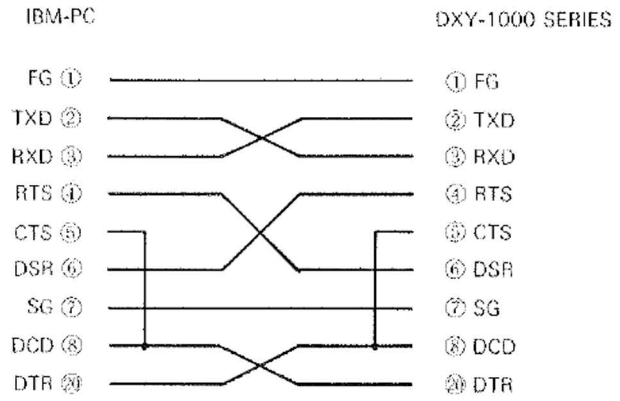
5.3 Information about Handshake

This section explains the handshaking system for a serial (RS-232C) interface. If the DXY-1000 series has a processing speed lower than the speed of data transmission, it may miss some data if preventive action is not taken. To receive all the data perfectly, the DXY-1000 series determines whether data transmission is acceptable according to the remaining capacity of the I/O buffer. This data transmission system is called a "handshake".
The DXY-1000 series supports three handshake modes: hardwire handshake, Xon/Xoff handshake and ENQ/ACK handshake.
The hardwire handshake uses the DTR pin of an RS-232C and lets the computer know whether it is ready to receive data from the DXY-1000 series. Besides this, the DXY-1000 series performs handshaking by sending a particular character from the same pin as used for data.
This section will explain the above three handshake modes as well as the software checking handshake that sends data from the computer using the device control commands while checking the remaining buffer capacity of the plotter buffer.

Note:
- In the examples below, a typical BASIC language is used in the concrete programs. Also, PRINT #1 and INPUT #1 indicate input and output of data when an RS-232C is used. In this case, you must have opened the RS-232C port.
- All character codes (ASCII codes) use decimals.
- Character codes are written in the form CHR$ (character code).
- Control characters like **[ESC]** are, for example, written in the form **[ESC]**CHR$(27). For information about device control commands, see "5.4 Device Control Commands" in Chapter 5.

5.3.1 Hardwire Handshake

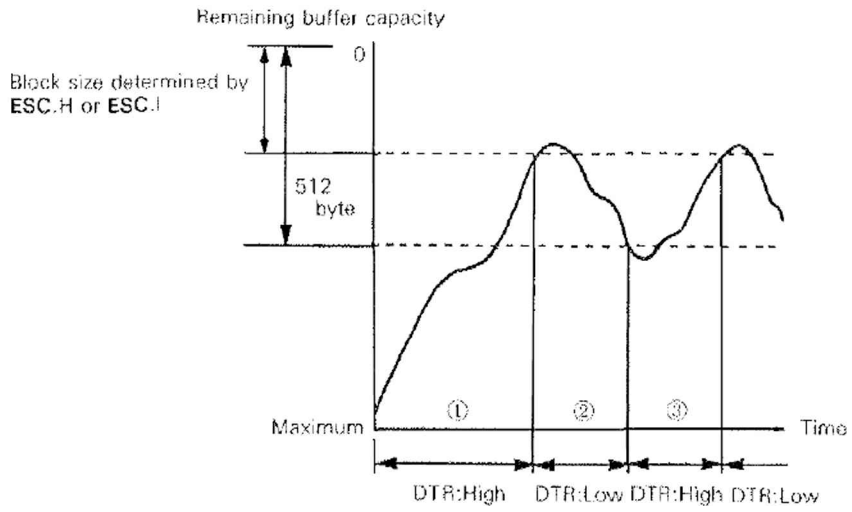
The DXY-1000 series has a function to switch the DTR pin of the RS-232C interface from "High" to "Low" according to the remaining buffer capacity. The DTR pin is the No.20 pin of the RS-232C.
If your computer has a function to stop the output of data when the input is low at the CTS or DSR pin of the RS-232C, a handshake by the hardware is available. A connection example for a hardwire handshake is shown in Fig. 5-6. Use this connection for IBM-PCs.



(XY-RS-11,13,31,33)

Fig. 5-6

How the hardwire handshake changes the remaining buffer capacity is shown in Fig. 5-7.



①If data is transmitted to the DXY-1000 series with the DTR pin "High" when a full buffer capacity (empty now) is available, the remaining buffer capacity gradually decreases because the data transmission speed is faster than the drawing speed.
②If the remaining buffer capacity is less than the block size (80 bytes are the default value) as determined by the 1st parameter of the ESC.H or ESC.I command, the DXY-1000 series sets the DTR pin to "Low". The remaining buffer capacity increases gradually because of no data transmission from the computer.
③If the remaining buffer capacity is larger than 512 bytes, the DXY-1000 series sets the DTR pin to "High". The computer then transmits the data again.

Fig. 5-7

The default after the power is turned ON means you are ready to use this hardwire handshake.
No matter what kind of handshake you set other than above, the DXY-1000 series switches the DTR pin from "High" to "Low" and vice versa according to the remaining buffer capacity. If this is inconvenient, you can fix the DTR pin at "High" with the 1st parameter of the ESC.@ command.

5.3.2 Software Checking Handshake

The DXY-1000 series has a function to output the remaining buffer capacity to a computer. By means of this function, the DXY-1000 sends data while checking the remaining buffer capacity.

Example of the software checking handshake:

```
100 ' DXY-1000 RS-232C DEVICE CONTROL  COMMAND
110 ' SAMPLE PROGRAM FOR SOFTWARE HANDSHAKE
120 OPEN "COM1:9600,N,8,1" AS #1
130 PRINT #1,CHR$(27);".M100;;;13:";
140 'MAIN PROGRAM

          GOSUB 1000 ┐
                     │
                     │  Main program for drawing
                     │
          GOSUB 1000 ┘

            END

1000 ' SUBROUTINE FOR BUFFER CHECK
1010   PRINT #1,CHR$(27);".B";
1020   INPUT #1,B
1030   PRINT "Buffer space :";B
1040   IF B>=500 THEN RETURN
1050   GOTO 1010
```

Explanation:

Line 120	Opens the RS-232C port. Grammar varies depending on computers.
Line 130	When the computer asks the DXY-1000 series to output, taking the delay time the DXY-1000 series takes to respond to the computer as 100m/sec, sets the terminator for data output from the DXY-1000 series to [ESC]CHR$(13).
Line 1010	Commands the DXY-1000 series to output the remaining buffer capacity to the computer.
Line 1020 to Line 1050	Checks the remaining buffer capacity and commands the DXY-1000 series to wait for data transmission.

In this sample program, the DXY-1000 series checks the remaining buffer capacity and controls the data transmission between Line 1000 and Line 1050. Because of this, GOSUB 1000 must be executed to check the remaining buffer capacity, as needed, in the main program. In other words, GOSUB 1000 must be executed so that incoming data do not overflow the remaining buffer capacity before the next GOSUB 1000 is executed.

5.3.3. Xon/Xoff Handshake

In this handshake mode, the DXY-1000 outputs the character specified as an Xoff character to the computer when the remaining buffer capacity is below a certain value. And it also outputs the character specified as an Xon character to the computer when the remaining buffer capacity is above a certain value. The computer stops the data transmission if an Xoff character is sent and starts the data transmission if an Xon character is sent. This Xon character is specified by the ESC.I command and this Xoff character by the ESC.N command. The remaining buffer capacity to output the Xon character is determined by the ESC.I command. The remaining buffer capacity to output an Xoff character is 512 bytes. A sample program for the Xon/Xoff handshake and an explanation of how it works are shown in Fig. 5-8.

Sample program:

```
100 ' DXY-1000 RS-232C DEVICE CONTROL  COMMAND
110 ' SAMPLE PROGRAM FOR Xon/Xoff HANDSHAKE
120 OPEN "COM1:9600,N,8,1" AS #1
130 ON COM GOSUB 1000
140   PRINT #1,CHR$(27);".M0;0;0;13;0;0:";
150   PRINT #1,CHR$(27);".I150;0;17:";
160   PRINT #1,CHR$(27);".N;19:";
170   PRINT #1,CHR$(27);".@;0:";
180   COM ON
190 ' MAIN PROGRAM ┐
                   │
                   │ Program for drawing
                   │
                   │
           END     ┘

1000 ' INTERRUPT Xon/Xoff
1010   IF LOC(1)=0 THEN RETURN
1020   A$=INPUT$(1,#1)
1030   IF A$=CHR$(19) THEN PRINT "Xoff  "
1040   PRINT "wait !!"
1050   A$=INPUT$(1,#1)
1060   IF A$=CHR$(17) THEN PRINT "Xon  ":COM ON:RETURN
1070   PRINT "ILLEGAL Xon !!"
1080   RETURN
```

Explanation:

Line 120 Opens the RS-232C port. Grammar varies depending on computers.

Line 140 Sets terminator for data output from the DXY-1000 series to [ESC]CHR$(13).

Line 150 Taking the limit of the remaining buffer capacity as 150 bytes, sets Xon character to [DC1]CHR$(17).

Line 160 Sets Xoff character to **[DC3]**CHR$(19).

Line 170 Sets the DTR pin to "High". In other words, does not allow the hardwire handshake to operate.

Line 1000 to Line 1060 Processes interrupt signals from the DXY-1000 series. The computer stops the data transmission if **[DC3]** is sent and starts it again if **[DC1]** is sent from the DXY-1000 series.

By setting Line 140 to line 170, the DXY-1000 series operates as follows:

(1) Outputs **[DC3]** as Xoff character if the remaining buffer capacity is below 150 bytes. (The computer stops the data transmission.)
(2) Outputs **[DC1]** as Xon character if the remaining buffer character is over 512 bytes. (The computer starts the data transmission.)

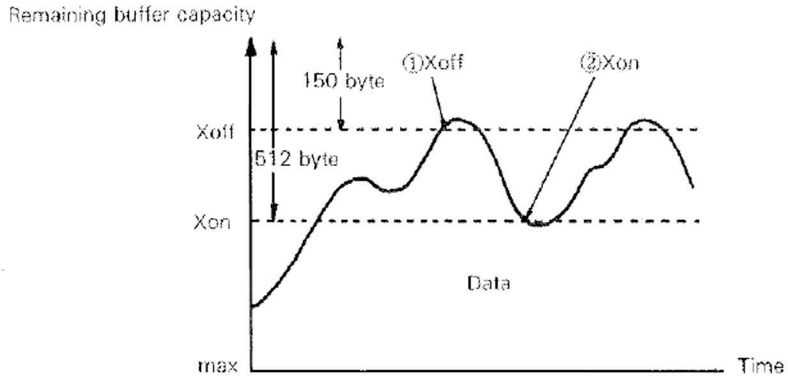


Fig. 5-8

In this program, the handshake is performed using interrupts under computer execution and so does not work properly unless the computer has the ability to accept interrupts. If the interrupt works properly, the computer jumps from Line 1000 to Line 1080 and waits until the next Xon signal is input if the interrupt signal is Xoff.

5.3.4 ENQ/ACK Handshake

In this handshake, the computer first sends the character specified as an ENQ character to the DXY-1000 series and asks whether it can transmit a certain amount of a data block. In response to this, the DXY-1000 series tells whether data transmission is acceptable by the character specified as an ACK character if the remaining buffer capacity is more than the above block data amount.

Furthermore, the ENQ/ACK handshake is divided into three modes : mode 1, mode 2 and dummy. Mode 1 is set by the **ESC.H** command, mode 2 by the **ESC.I** command and dummy by the **ESC.H** command without any parameter.
In the dummy ENQ/ACK, especially if you do not set any ENQ or ACK character, the DXY-1000 series returns the ACK character to the computer unconditionally when receiving the ENQ character.

The difference between mode 1 and mode 2 is shown in Fig. 5-9. If handshake outputs (such as output trigger character, echo terminator character and output terminator) have been set in mode 1, they are sent with the procedure shown in Fig. 5-9. Even if these handshake outputs have been set in mode 2, they are ignored. For more information, see "5.3.5 Handshake Output Specifications".

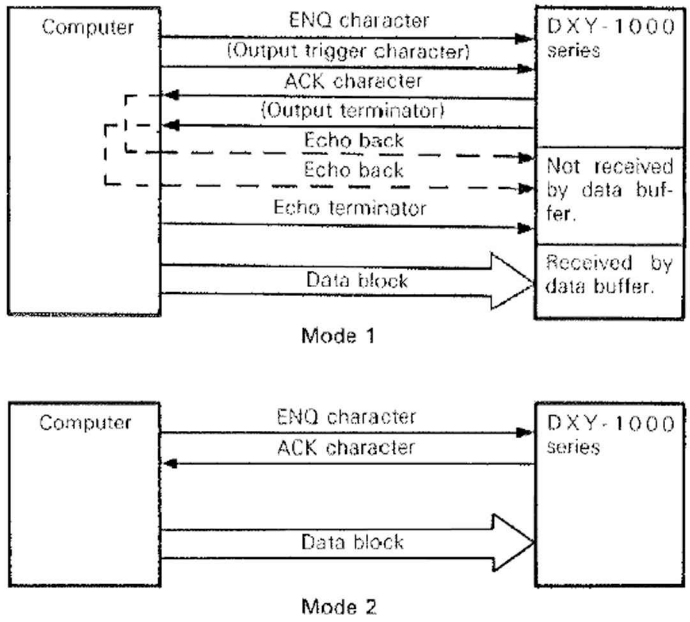


Fig. 5-9

A program example of "ENQ/ACK Handshake Mode 1" is shown below.

First of all, without outputting drawing data to the DXY-1000 series, this program writes those data to a data file called "DATA1". Next, it opens DATA1 to execute Example 2. "Tasks other than DATA1" refers to any tasks other than drawing done a computer using the extra time caused by buffering the DXY-1000 series.

Example 1:

```
10 OPEN "1:DATA1" FOR OUTPUT AS #1
20 PRINT #1,"..........."
                                    ] Data for the DXY-1000 series
1000 END
```

Example 2:

```
100 ' DXY-1000 RS-232C DEVICE CONTROL COMMAND
110 ' SAMPLE PROGRAM FOR ENQ/ACK HANDSHAKE
120 '
130 OPEN "COM1:9600,N,8,1" FOR OUTPUT AS #1 : OPEN
"DATA1" FOR INPUT AS #2
140 ON COM GOSUB 1000
150 COM ON
160 '<<<  SET HANDSHAKE MODE ENQ/ACK  >>>
170  PRINT #1,CHR$(27);".K";
180  PRINT #1,CHR$(27);".R";
190  PRINT #1,CHR$(27);".@;0:";
200  PRINT #1,CHR$(27);".M100;00;00;13;00;00:";
210  '  ENQ character = CHR$(5)
220  '  ACK character = CHR$(6)
230 PRINT #1,CHR$(27);".H256;5;6:";
240 '<<<  MAIN PROGRAM  >>>
250 PRINT "***ENQ !!":PRINT #1,CHR$(5);
.                                                  Tasks other than
.                                                  DATA1
.
END
1000 ' <<  BLOCK TRANSFER  >>
1010 COM OFF
1020  PRINT "ACK !!":INPUT #1,ACK$
1030  IF ACK$<>CHR$(6) THEN COM ON:RETURN
1040  FOR I=1 TO 256
1050    IF EOF(2) THEN GOTO 1120
1060    A$=INPUT$(1,#2)
1070    PRINT #1,A$;
1080    PRINT A$;
1090  NEXT I
1100 COM ON
1110  PRINT "***ENQ !!":PRINT #1,CHR$(5);:RETURN
1120  PRINT "DATA END !!":RETURN
```

Explanation:

Line 130	Opens two files. Modify the command, to open a file depending on the individual computer.
Line 140 to Line 150	Sets interrupt processing.
Line 170	Clears buffer data of the DXY-1000 series
Line 180	Initializes settings for handshake.
Line 190	Sets both monitor mode and hardwire handshake mode to OFF.
Line 200	Taking the delay time until the DXY-1000 series starts outputting as 100 m/sec, sets the output terminator to [CR]CHR$(13).
Line 230	Taking the ENQ code as [ENQ]CHR$(5) and the ACK code as [ACK]CHR$(6), sets the data block to 256 bytes.
Line 1000 to Line 1120	Gets out of the main program by interrupt with an ACK signnal from the DXY-1000 series. Sets the DATA1 to a 256 byte data block to output them to the DXY-1000 series.

With the setting of Line 230, the computer sends the [ENQ]CHR$(5) to the DXY-1000 series. Then the DXY-1000 series returns the [ACK]CHR$(6) as an ACK character to the computer if the remaining buffer capacity is more than 256 bytes.
In this program, the computer checks the plotter's condition in the main program and outputs one block (256 byte plotter data) using an interrupt if the buffer still has extra space. If the buffer has no extra space or no output data in it, the computer processes "Tasks other than DATA1".

5.3.5 Handshake Output Specifications

The Xon/Xoff and the ENQ/ACK handshake have different output specifications from each other, depending on the settings of the device control commands, as shown in Table 5-4. "○" indicates effective output specifications, but "×" indicates ineffective output specifications even if they have been set. Also, these output specifications may be affected if they are output by the RD-GL I output commands.

Output specifications	NEQ/ACK		Xon/Xoff	Output by RD-GL I	Setting command (Parameter)
	mode1	mode2			
Delay time	○	○	×	○	ESC.M(P1)
Output trigger character	○	×	×	○	ESC.M(P2)
Echo terminator	○	×	×	○	ESC.M(P3)
Output terminator	○	×	×	○	ESC.M(P4,P5)
Output initiator	×	×	×	○	ESC.M(P6)
Intercharacter delay	○	○	○	○	ESC.N(P1)
Immediate response character	○	○	×	×	ESC.N(P2 ~ P11)

Table 5-4

Delay time:
This is the delay time (m/sec) before the DXY-1000 series starts outputting when the computer asks it to do so, thereby preventing any date transmission from the DXY-1000 series before the computer is ready to receive data.

Output trigger character:
The computer sends this character at the end of an output command sent to the DXY-1000 series.
Even if you set this character, the DXY-1000 series does not output until the character is sent. For this, **[DC1]**CHR$(17) is often used. The default value is 0 (for nothing set).

Echo terminator:
This is used by the computer to echo data sent from the DXY-1000 series back to the DXY-1000 series again. If you set this echo terminator so that the reception of echoback data does not cause an error, the DXY-1000 series ignores input until receiving this character. For this **[LF]**CHR$(10) is often used. The defaultvalue is 0 (for nothing set).

Output terminator:
This character is sent after at the end of all the data output by the DXY-1000 series. The default value is **[CR]**CHR$(13).

Output initiator:
The DXY-1000 series sends this character at the beginning of the data which it outputs to the computer. Depending on the computer, is may be necessary to send this character as a sign that the DXY-1000 series is ready to do data transmission before actually sending data. For this **[STX]**CHR$(2) is often used. The default value is 0 (for nothing set).

Intercharacter delay:
This is the delay time (m/sec) between characters within a character string that the DXY-1000 series outputs to the computer. Depending on computers, one may not be able to do data transmission if there is not enough delay time between characters the DXY-1000 outputs. In such a case, this character is set. The default value is 0(m/sec).

Immediate response character:
When the ENQ/ACK handshake is set, this character is output before the ACK character. Depending on computers, one may ask the DXY-1000 series to give an immediate response after sending the ENQ character. In such a case, if you set this character, the computer returns the character back immediately after receiving the ENQ character. For this, **[DC3]**CHR$(19) is often used. The default value is 0 (for nothing set).

5.4 Device Control Commands

The device control command is used to determine the communication protocol between a computer with an RS-232C interface and the DXY-1000 series and let the computer know the current status of the DXY-1000 series. There are also device control commands to set the specifications for output by RD-GL I commands.
The device control command consists of three characters, such as **[ESC]**CHR$(27),".", the last of which is a capital letter or a symbol. And it is divided into two kinds: one with parameters and one without parameters.
Parameters may be omitted. A semicolon ";" is used on a delimiter to separate parameters. A semicolon ";" without parameters indicates that parameters are omitted. For the device control command with parameters, you are required to key in terminator at the end of an instruction sentence. A colon ":" is used for the terminator and this cannot be omitted.

5.4.1 Handshake Mode Commands

ESC.B	Remaining buffer capacity output

●FORMAT
[ESC].B

●EXPLANATION
This command tells the DXY-1000 series to output the current remaining buffer capacity to the computer. Since the computer knows the remaining buffer capacity with this command, it can output data below this capacity to the DXY-1000 series. Therefore, using this command allows you to prevent the buffer from an overflow. See "Example" of "5.3.2 Software Checking Handshake".

ESC.M	Set handshake output specification (1)

●FORMAT
[ESC].M P1;P2;P3;P4;P5;P6:

●EXPLANATION
This command sets the output specifications for handshaking.

P1:

When the computer asks the DXY-1000 series to output, the parameter P1 sets the delay time until the DXY-1000 series starts outputting. The parameter range is from 0 to 65535. The unit is m/sec. A decimal parameter will cause an error. (Default value: 0)

```
EXAMPLE:  PRINT #1,CHR$(27);".M100:";
```

This command sets an approximately 100m/sec delay time.

P2:

Parameter P2 sets an output trigger charcter. For more information about the output trigger character, see "5.3.5 Handshake Output Specifications". This character is also applicable to the output of RD-GL I output commands.
(Default value: 13[CR])

EXAMPLE: `PRINT #1,CHR$(27);".M;13:";`

P1 is set to 0 (default value). The output trigger character is the carriage return [CR]CHR$(13). For example, if you send the ESC.B command to the DXY-1000 series and the carriage return [CR] thereafter, the DXY-1000 series outputs the remaining buffer capacity to the computer.

P3:

Parameter P3 sets an echo terminator. For more information about the echo terminator, see "5.3.5 Handshake Output Specifications". The echo terminator is also applicable to the output of RD-GL I output commands.
(Default value: 0)

EXAMPLE: `PRINT #1,CHR$(27);".M;;1Ø:";`

In this example, parameters P1 and P2 are set to the default values and the echo terminator is set to line feed [LF]CHR$(10). Thus, the computer must output the line feed [LF] at the end of echoback data so that the DXY-1000 series will accept input.

P4 and P5:

These parameters set an output terminator. The output terminator is the last character sent following the data output by the DXY-1000 series and is made up of one or two characters. This terminator is also applicable to the output of RD-GL I output commands.
(Default value: 13[CR] for P4 and 0 for P5)

EXAMPLE:
```
(1) PRINT #1,CHR$(27);".M;;;13:";
(2) PRINT #1,CHR$(27);".M;;;13;1Ø;Ø:";
```

(1) outputs [CR]CHR$(13) as the output terminator and (2) [CR] and [LF]CHR$(10). But in the case of two characters, as in (2), you must set P6 to 0 (default value).

P6:

This parameter sets an output initiator. For more information about the output initiator, see "5.3.5 Handshake Output Specifications". When you set the output initiator, you must set parameter P5 to 0 (default value). The output initiator is also applicable to the output of RD– GL I output commands.
(Default value: 0)

EXAMPLE: `PRINT #1,CHR$(27);".M;;;13;Ø;33:";`

This command outputs an exclamation "" (CHR$(33)) before the data sent by the DXY-1000 series to the computer.

ESC.N	Set handshake output specification (2)

●FORMAT

[ESC].N P1;P2;....;P11:

●EXPLANATION

This command sets an intercharacter delay and also sets an Xoff character for the Xon/X-off handshake.

P1:

This parameter sets an intercharacter delay. The parameter range is from 0 to 32767.4999, and the unit is m/sec. For more information about the intercharacter delay, see "5.3.5 Handshake Output Specifications" in Chapter 5. This setting is applicable both to the handshake modes and to the output of RD-GL I output commands.
(Default value: 0)

```
EXAMPLE:  PRINT #1,CHR$(27);".N10:";
```

For example, when you send the [ESC].L command to the DXY-1000 series, the DXY-1000 series outputs "1024CHR$(13)". At this time, each character or terminator is sent to the computer at intervals of 10m/sec.

P2 to P11:

These parameters set an Xoff character when the Xon/Xoff handshake has been set (see **ESC .I** command).
When the ENQ/ACK handshake has been set, the parameters also set an immediate response character. For more information about the immediate response character, see "5.3.5 Handshake Output Specifications" in Chapter 5.
You can set up to 10 characters.
(Default value: 0 for all parameters)

ESC.H	Set ENQ/ACK handshake mode 1

●FORMAT

[ESC].H P1;P2;P3;....;P12:

●EXPLANATION

This command does settings in the ENQ/ACK handshake mode 1. When the computer sends the ENQ character set by parameter P2 to the DXY-1000 series, the DXY-1000 series outputs the ACK character set by parameter P3 only if the remaining buffer capacity is above the value set by P1. After the ACK character is returned, the computer can then send a block of data to the plotter equal to the number of bytes specified by P1.
If you omit all the parameters when sending the **ESC.H** command, the handshake is not available. But when the computer sends an ENQ character to the DXY-1000, the DXY-1000 always outputs an ACK character regardless of the remaining buffer capacity. This is called a "dummy handshake".

P1:

This parameter sets the byte number of a data block sent from the computer to the DXY-1000 series. When receiving an ENQ character, the DXY-1000 series outputs an ACK character if the remaining buffer capacity is above the values set by the P1. The parameter range of P1 is from 0 to 15358.
(Default value: 80)

P2:

This parameter sets an ENQ character. For this character, usually **[ENQ]**CHR$(5) is used. But if you specify 0, the ENQ/ACK handshake is not set.
(Default value: 0)

P3 to P12:

These parameters set an ACK character only if you set P2. You can set up to 10 characters. For this character, usually **[ACK]**CHR$(6) is used. If you specify 0, any ACK character is not output, but only the output terminator set by the **ESC**.M command is output.
(Default value: 0)

EXAMPLE:
```
PRINT #1,CHR$(27);".H128;5;6:";
```

In this case, the byte number of a data block becomes 128. The ENQ character is **[ENQ]**CHR$(5) and the ACK character is **[ACK]**CHR$(6).

ESC.I	Set Xon/Xoff handshake and ENQ/ACK handshake mode 2

●FORMAT

[ESC].I P1;P2;P3;....;P12:

●EXPLANATION

This command is used when you want the Xon/Xoff handshake and the ENQ/ACK handshake mode 2. If you omit all the parameters (in case you send **[ESC]**.I:), handshakes are not available. If the computer sends an ENQ character to the DXY-1000 series, the DXY-1000 series always outputs an ACK character. This is also called a "dummy handshake".

P1:

For the Xon/Xoff handshake, this parameter sets the limit of the remaining buffer capacity. If the remaining buffer capacity is below the values set by the parameter p1, the DXY-1000 series outputs an Xoff character.
For the ENQ/ACK handshake mode 2, the parameter P1 sets the size of a data block. The parameter range is from 10 to 15358.
(Default value: 80)

EXAMPLE:
```
PRINT #1,CHR$(27);".I100;;17:";CHR$(27);".N;
19:";
```

If the remaining buffer capacity reaches 100 bytes, the DXY-1000 series outputs an Xoff character **[DC1]**.

P2:

For the ENQ/ACK handshake mode 2, parameter P2 sets an ENQ character. If you specify 0 for this parameter, nothing can be sent. For the Xon/Xoff handshake, set 0 for the parameter.
(Default value: 0)

```
EXAMPLE:  PRINT #1,CHR$(27);".I;Ø;17:";
          PRINT #1,CHR$(27);".N;19:";
```

P3 to P12:

For the Xon/Xoff handshake, these parameters set an Xon character.
For the ENQ/ACK handshake mode 2, these parameters set an ACK character.
You can set up to 10 characters, each separated by a semicolon ";". A terminator set by the **ESC**.M command cannot be output. Specifying 0 sends nothing.
(Default value: 0 for all parameters)

```
EXAMPLE:  PRINT #1,CHR$(27);".I;5;6:";
```

This command enables the ENQ/ACK handshake. The ENQ character is set to [ENQ]CHR$(5), the ACK character to [ACK]CHR$(6) and the data block size to 80 bytes, respectively.

```
EXAMPLE:  PRINT #1,CHR$(27);".I8Ø;Ø;17:" ; CHR$(27);".N;19:";
```

This command enables the Xon/Xoff handshake. The Xon character is set to [DC1]CHR(17), the Xoff character to [DC3]CHR$(19) and the limit of the remaining buffer capacity to 80 bytes, respectively.

5.4.2 Status Commands

ESC.O	Output plotter status

●FORMAT
[ESC].O

●EXPLANATION
This command outputs to the computer the presence or absence of data in the buffer as well as the status of the DXY-1000 series according to the codes shown in Table 5-5.

Code	Buffer capacity status
0	Buffer is not empty
8	Buffer is empty
16	Buffer is not empty, and plotter is on standby*
24	Buffer is empty, and plotter is on standby*

*The PAUSE indicator lights.

Table 5-5

ESC.E	Output error code

●FORMAT
[ESC].E

●EXPLANATION
When this command is received, the DXY-1000 series outputs error codes about the RS-232C interface, as shown in Table 5-6. At the same time, errors are cleared.

Error codes	Error contents
0	An I/O error has not occurred.
10	While an output request is being executed, another command requesting output has been received, but only the first command is valid.
11	A device control command error has occurred.
12	A device control command parameter is unsuitable. (The parameter causing the error is set to the default value.)
13	A parameter overflow has occurred.
14	Too many parameters have been input, or the parameters were not terminated by ";".
15	A framing error, parity error, or overrun error has occurred during reception of data.
16	The I/O buffer has overflowed. (In this case normal drawing operation is impossible.)

Table 5-6

ESC.L	Output I/O buffer size

●FORMAT
[ESC].L

●EXPLANATION
When this command is received, the DXY-1000 series outputs the current size of the I/O buffer to the computer, usually outputting 1024 bytes.

Note: Even with a 1M byte buffer, it will answer "1024".

5.4.3 Abort Commands

ESC.J	Abort device control

●FORMAT
[ESC].J

●EXPLANATION
This command aborts the device control commands under execution.

ESC.K	Abort command

●FORMAT
[ESC].K

●EXPLANATION
This command executes one vector of the currently-active DXY-GL or RD-GL I command, aborts all other subsequent commands and clears the data buffer.

ESC.R	Reset device control

●FORMAT
[ESC].R

●EXPLANATION
This command sets all the settings of the device control commands to their default values.
When ESC.R is executed, the results are the same as executing the device control commands below.

[ESC].J
[ESC].M:
[ESC].N:
[ESC].H:
[ESC].I:
[ESC].@:

5.4.4 Monitor Mode Commands

The DXY-1000 series is capable of outputting data sent from the computer to a terminal and so forth. Cables used for this purpose should be wired as shown in "5.2.2 Y-Connection"in Chapter 5, Fig. 5-4 with the DIP Switch 2-④ turned ON (Y-DROP).

ESC.Y ESC.(	Plotter ON

●FORMAT
[ESC].Y or [ESC].(

●EXPLANATION
After the power is turned ON in the Y-DROP mode (DIP Switch 2-④ is ON), the DXY-1000 series ignores all data until is receives this command. The ignored data are output through pin No.14 of the RS-232C connector to the terminal.

ESC.Z ESC.)	Plotter OFF

●FORMAT
[ESC].Z or [ESC].)

●EXPLANATION
When receiving this command, the DXY-1000 series ignores further data.
When receiving the **ESC**.Y or **ESC**.(commands, this plotter will execute a drawing with the data that follow.

ESC.@	Set monitor mode and DTR control

●FORMAT
[ESC].@P1;P2:

●EXPLANATION
P1:

This sets the size of the plotter's I/O buffer. The parameter range is 0 to 9999, but if it is larger than the initial value of 1024 then it will be set to 1024.

P2:

When the control of DTR signals (pin No.20 of the RS-232C connector) and the DIP Switch 2-④ are ON (Y-DROP), this parameter sets the monitor mode. For more information about the DTR signals and the monitor mode, see "5.3.1 Hardware Handshake" and "5.2.2 Y-DROP", respectively.
The parameter range is from 0 to 255. The parameter value is the sum of bit values shown in Table 5-7.
(Default value: 1)

Bit No.	Bit value	Contents
0	1	When this bit is 0, no hardware handshake is done. DTR signal is always at "High". When this bit is 1, hardware handshake is performed.
1	2	Ignored.
2	4	When this bit is 0, sets monitor mode 1. When this bit is 1, sets monitor mode 2.
3	8	When this bit is 0, turns monitor mode OFF. When this bit is 1, turns monitor mode ON.
4 5 6 7	16 32 64 128	Ignored.

Table 5-7

EXAMPLE 1 `PRINT #1,CHR$(27);".@;Ø:";`

This command sets the monitor mode to OFF and DTR signals to ON. At this time, any data after the **ESC**.Y command are taken into the DXY-1000 series and so are not output to a terminal. Also, handshake is not available.

EXAMPLE 2 `PRINT #1,CHR$(27);".@;8:";`

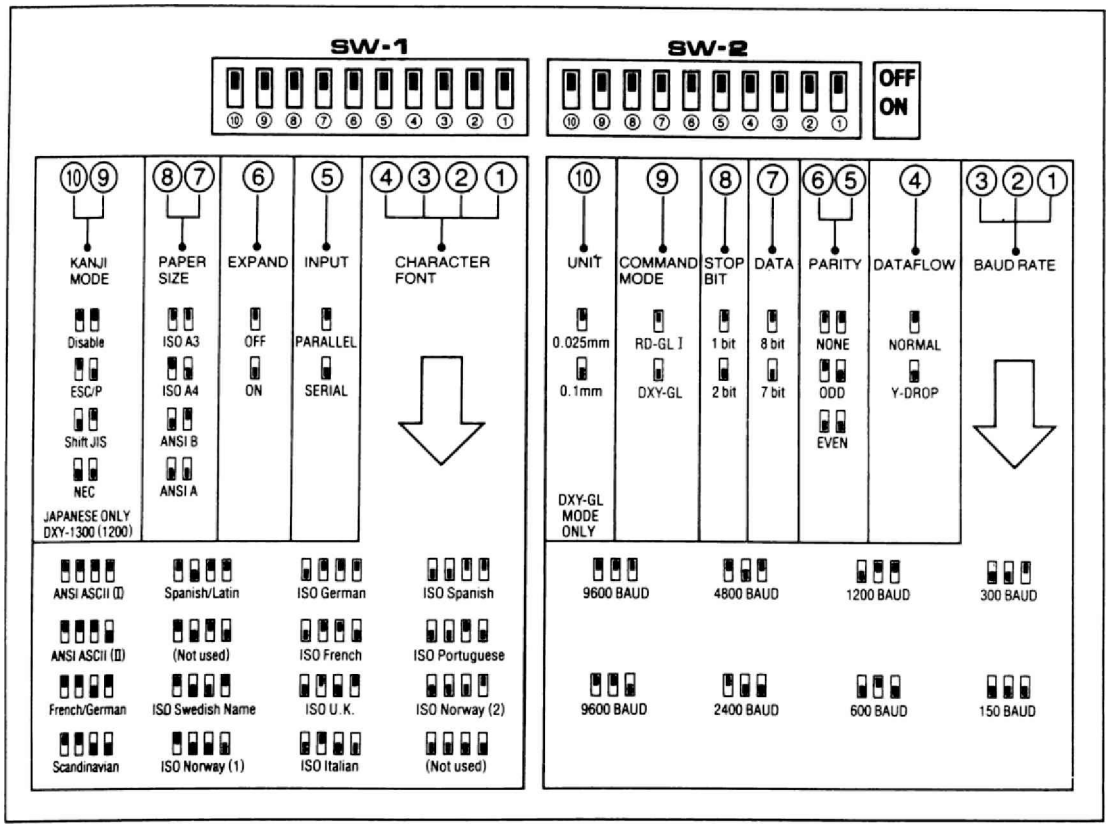
When DIP Switch 2-④ is ON (Y-DROP), this command turns the monitor mode ON and sets mode 1. In this mode, the DXY-1000 series outputs the data currently under execution to the terminal.

EXAMPLE 3 `PRINT #1,CHR$(27);".@;12:";`

When DIP Switch 2-④ is ON (Y-DROP), this command turns the monitor mode ON and sets mode 2. In this mode, the DXY-1000 series outputs the data received from the computer to the terminal.

APPENDIX

App.A DIP Switch Setting Table



Paper	Paper Size	Maximum Plotting Area	DIP Switch Setting SW1-6	SW1-7	SW1-8
ISO A3	420×297mm	403.950×276mm	OFF	OFF	OFF
ISO A4	297×210mm	276×193.025mm	OFF	ON	OFF
ANSI B	431.8×279.4mm 17×11inch	416×259.125mm 16.37×10.20inch	OFF	OFF	ON
ANSI A	279.4×215.9mm 11×8.5inch	259.125×199.05mm 10.20×7.83inch	OFF	ON	ON
EXPAND		431.8×297mm 17×11.69inch	ON	–	–

[Functions]

SW1-①~④

Select character sets out of the 19 sets of the DXY-1000 series for the initial font setting.

SW1-⑤

Set according to whether the connection with the computer is parallel (centronics) or serial (RS-232C).

SW1-⑥

Set the maximum plotting area, which will accomodate both ISO A3 and ANSI B sizes.

SW1-⑦⑧

Set the paper size according to ISO(A3/A4) or ANSI(B/A).

SW2-①~⑧

Set the same as the computer side in term of baudrate, parity check, and other conditions when a serial (RS-232C) connection is applied.

SW2-⑨

Set the command mode according to RD-GL I or DXY-GL

SW2-⑩

Set the operation step (Software resotution) in the DXY-GL command mode.

A

App.B Control Code Table

Decimal	ASC II Character	Function
0	NULL	Nop
1	SOH	Nop
2	STX	Nop
3	ETX	End Label Command
4	EOT	Nop
5	ENQ	RS-232C
6	ACK	Nop
7	BEL	Nop
8	BS	Backspace (Moves left one space)
9	HT	Horizontal tab (Moves left half a space)
10	LF	Line Feed (Feeds one line down)
11	VT	Inverse Line Feed (Feeds one line up)
12	FF	Nop
13	CR	Carriage Return (Moves to head of line)
14	SO	Select Alternate Character Set
15	SI	Select Standard Character Set
16	DLE	Nop
17	DC1	Nop
18	DC2	Nop
19	DC3	Nop
20	DC4	Nop
21	NAK	Nop
22	SYN	Nop
23	ETB	Nop
24	CAN	Nop
25	EM	Nop
26	SUB	Nop
27	ESC	Nop
28	FS	Nop
29	GS	Nop
30	RS	Nop
31	US	Nop
32	SP	Space

For more information about the range of character codes from 33 to 126 (decimal), see Appendix C "Character Set Table".

App.C Character Set Table

Hexdecimal code	Decimal code	Character set																	
		0	1	2	3	4	6	7	8	9	30	31	32	33	34	35	36	37	38	39
21	33	!	!	!	!	!	!	À	｡	!	!	!	!	!	!	!	!	!	!	!
22	34	"	"	"	"	"	"	Â	「	"	"	"	"	"	"	"	"	"	"	"
23	35	#	#	£	£	¿	#	È	」	#	#	#	#	#	£	£	£	£	#	§
24	36	$	$	$	$	$	$	Ê	、	¤	¤	¤	$	$	$	$	$	$	$	$
25	37	%	%	%	%	%	%	Ë	ｰ	%	%	%	%	%	%	%	%	%	%	%
26	38	&	&	&	&	&	&	Î	ヲ	&	&	&	&	&	&	&	&	&	&	&
27	39	'	'	´	'	´	'	Ï	ァ	'	'	'	'	'	'	'	'	'	'	'
28	40	(	(	(	(	(	(	´	ィ	(	(	(	(	(	(	(	(	(	(	(
29	41	)	)	)	)	)	)	`	ゥ	)	)	)	)	)	)	)	)	)	)	)
2A	42	*	*	*	*	*	*	^	ェ	*	*	*	*	*	*	*	*	*	*	*
2B	43	+	+	+	+	+	+	¨	ォ	+	+	+	+	+	+	+	+	+	+	+
2C	44	,	,	,	,	,	,	~	ャ	,	,	,	,	,	,	,	,	,	,	,
2D	45	−	−	−	−	−	−	Ù	ュ	−	−	−	−	−	−	−	−	−	−	−
2E	46	.	.	.	.	.	.	Û	ョ	.	.	.	.	.	.	.	.	.	.	.
2F	47	/	/	/	/	/	/	£	ッ	/	/	/	/	/	/	/	/	/	/	/
30	48	0	0	0	0	0	0	¯	ｰ	0	0	0	0	0	0	0	0	0	0	0
31	49	1	1	1	1	1	1		ア	1	1	1	1	1	1	1	1	1	1	1
32	50	2	2	2	2	2	2		イ	2	2	2	2	2	2	2	2	2	2	2
33	51	3	3	3	3	3	3		ウ	3	3	3	3	3	3	3	3	3	3	3
34	52	4	4	4	4	4	4	Ç	エ	4	4	4	4	4	4	4	4	4	4	4
35	53	5	5	5	5	5	5	ç	オ	5	5	5	5	5	5	5	5	5	5	5
36	54	6	6	6	6	6	6	Ñ	カ	6	6	6	6	6	6	6	6	6	6	6
37	55	7	7	7	7	7	7	ñ	キ	7	7	7	7	7	7	7	7	7	7	7
38	56	8	8	8	8	8	8	¡	ク	8	8	8	8	8	8	8	8	8	8	8
39	57	9	9	9	9	9	9	¿	ケ	9	9	9	9	9	9	9	9	9	9	9
3A	58	:	:	:	:	:	:	¤	コ	:	:	:	:	:	:	:	:	:	:	:
3B	59	;	;	;	;	;	;	£	サ	;	;	;	;	;	;	;	;	;	;	;
3C	60	<	<	<	<	<	<	¥	シ	<	<	<	<	<	<	<	<	<	<	<
3D	61	=	=	=	=	=	=	§	ス	=	=	=	=	=	=	=	=	=	=	=
3E	62	>	>	>	>	>	>	ƒ	セ	>	>	>	>	>	>	>	>	>	>	>
3F	63	?	?	?	?	?	?	¢	ソ	?	?	?	?	?	?	?	?	?	?	?
40	64	@	@	@	@	@	@	â	タ	@	@	É	@	§	à	@	§	§	§	@

⬚ Automatic backspace

C

Hexdecimal code	Decimal code	Character set																		
		0	1	2	3	4	6	7	8	9	30	31	32	33	34	35	36	37	38	39
41	65	A	A	A	A	A	A	ê	チ	A	A	A	A	A	A	A	A	A	A	A
42	66	B	B	B	B	B	B	ô	ツ	B	B	B	B	B	B	B	B	B	B	B
43	67	C	C	C	C	C	C	û	テ	C	C	C	C	C	C	C	C	C	C	C
44	68	D	D	D	D	D	D	á	ト	D	D	D	D	D	D	D	D	D	D	D
45	69	E	E	E	E	E	E	é	ナ	E	E	E	E	E	E	E	E	E	E	E
46	70	F	F	F	F	F	F	ó	ニ	F	F	F	F	F	F	F	F	F	F	F
47	71	G	G	G	G	G	G	ú	ヌ	G	G	G	G	G	G	G	G	G	G	G
48	72	H	H	H	H	H	H	à	ネ	H	H	H	H	H	H	H	H	H	H	H
49	73	I	I	I	I	I	I	è	ノ	I	I	I	I	I	I	I	I	I	I	I
4A	74	J	J	J	J	J	J	ò	ハ	J	J	J	J	J	J	J	J	J	J	J
4B	75	K	K	K	K	K	K	ù	ヒ	K	K	K	K	K	K	K	K	K	K	K
4C	76	L	L	L	L	L	L	ä	フ	L	L	L	L	L	L	L	L	L	L	L
4D	77	M	M	M	M	M	M	ë	ヘ	M	M	M	M	M	M	M	M	M	M	M
4E	78	N	N	N	N	N	N	ö	ホ	N	N	N	N	N	N	N	N	N	N	N
4F	79	O	O	O	O	O	O	ü	マ	O	O	O	O	O	O	O	O	O	O	O
50	80	P	P	P	P	P	P	Å	ミ	P	P	P	P	P	P	P	P	P	P	P
51	81	Q	Q	Q	Q	Q	Q	î	ム	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
52	82	R	R	R	R	R	R	Ø	メ	R	R	R	R	R	R	R	R	R	R	R
53	83	S	S	S	S	S	S	Æ	モ	S	S	S	S	S	S	S	S	S	S	S
54	84	T	T	T	T	T	T	å	ヤ	T	T	T	T	T	T	T	T	T	T	T
55	85	U	U	U	U	U	U	í	ユ	U	U	U	U	U	U	U	U	U	U	U
56	86	V	V	V	V	V	V	ø	ヨ	V	V	V	V	V	V	V	V	V	V	V
57	87	W	W	W	W	W	W	æ	ラ	W	W	W	W	W	W	W	W	W	W	W
58	88	X	X	X	X	X	X	Ä	リ	X	X	X	X	X	X	X	X	X	X	X
59	89	Y	Y	Y	Y	Y	Y	ì	ル	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
5A	90	Z	Z	Z	Z	Z	Z	Ö	レ	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
5B	91	[	[	[	Ø	[	[	Ü	□	[	Ä	Ä	Æ	Ä	•	[	•	¡	Ã	Æ
5C	92	\	√	ç	Æ	¡	¥	É	ワ	\	Ö	Ö	Ø	Ö	ç	\	ç	Ñ	Ç	Ø
5D	93	]	]•	]	ø	]	]	ï	ン	]	Å	Å	Å	Ü	§	]	é	¿	Õ	Å
5E	94	^	↑	^	æ	^	^	ß	•	^	^	Ü	^	^	^	^	^	^	^	^
5F	95	_	_	_	_	_	_	Ô	°											
60	96	`	`	`	`	`	`	Á		`	`	é	`	`	`	`	ù	`	`	`

Hexdecimal code	Decimal code	Character set																		
		0	1	2	3	4	6	7	8	9	30	31	32	33	34	35	36	37	38	39
61	97	a	a	a	a	a	a	Ã		a	a	a	a	a	a	a	a	a	a	a
62	98	b	b	b	b	b	b	ã		b	b	b	ḡ	b	b	b	b	b	b	b
63	99	c	c	c	c	c	c	Đ		c	c	c	c	c	c	c	c	c	c	c
64	100	d	d	d	d	d	d	đ		d	d	d	d	d	d	d	d	d	d	d
65	101	e	e	e	e	e	e	Í		e	e	e	e	e	e	e	e	e	e	e
66	102	f	f	f	f	f	f	Ì		f	f	f	f	f	f	f	f	f	f	f
67	103	g	g	g	g	g	g	Ó		g	g	g	g	g	g	g	g	g	g	g
68	104	h	h	h	h	h	h	Ò		h	h	h	h	h	h	h	h	h	h	h
69	105	i	i	i	i	i	i	Õ		i	i	i	i	i	i	i	i	i	i	i
6A	106	j	j	j	j	j	j	õ		j	j	j	j	j	j	j	j	j	j	j
6B	107	k	k	k	k	k	k	Š		k	k	k	k	k	k	k	k	k	k	k
6C	108	l	l	l	l	l	l	š		l	l	l	l	l	l	l	l	l	l	l
6D	109	m	m	m	m	m	m	Ú		m	m	m	m	m	m	m	m	m	m	m
6E	110	n	n	n	n	n	n	Ÿ		n	n	n	n	n	n	n	n	n	n	n
6F	111	o	o	o	o	o	o	ÿ		o	o	o	o	o	o	o	o	o	o	o
70	112	p	p	p	p	p	p	Þ		p	p	p	p	p	p	p	p	p	p	p
71	113	q	q	q	q	q	q	þ		q	q	q	q	q	q	q	q	q	q	q
72	114	r	r	r	r	r	r			r	r	r	r	r	r	r	r	r	r	r
73	115	s	s	s	s	s	s			s	s	s	s	s	s	s	s	s	s	s
74	116	t	t	t	t	t	t			t	t	t	t	t	t	t	t	t	t	t
75	117	u	u	u	u	u	u			u	u	u	u	u	u	u	u	u	u	u
76	118	v	v	v	v	v	v	–		v	v	v	v	v	v	v	v	v	v	v
77	119	w	w	w	w	w	w	¼		w	w	w	w	w	w	w	w	w	w	w
78	120	x	x	x	x	x	x	½		x	x	x	x	x	x	x	x	x	x	x
79	121	y	y	y	y	y	y	a		y	y	y	y	y	y	y	y	y	y	y
7A	122	z	z	z	z	z	z	o		z	z	z	z	z	z	z	z	z	z	z
7B	123	{	π				{	«		{	ä	ä	æ	ä	é	{	à	•	ã	æ
7C	124	|	⊢				|	□		|	ö	ö	ø	ö	ù	|	ò	ñ	ç	ø
7D	125	}	→				}	»		}	å	å	å	ü	è	}	è	ç	õ	å
7E	126	~	~	'	•	~	~	±		–	–	ü	–	ß	¨	–	ì	~	•	|
7F	127																			

App.D Command Table

DXY-GL Commands

Command		Format	Parameter	Parameter range (Default value)	Page
A	Circle Center	Ax,y	xy: X and Y center coordinates	−32768.0000 to +32767.4999	2-3
B	Line Scale	B ℓ	ℓ: Pitch of dotted line	ℓ =0 to 32767.4999 (80)	2-3
C	Circle	Cx,y,r,θ1,θ2 (,θd)	x,y: X and Y center coordinates r: Radius θ1: Start angle θ2: End angle θd: Resolution	x,y,r: −32768.0000 to +32767.4999 θ1,θ2: −32767° to +32767° θd: 1° to 179.9999°(5°)	2-5
D	Draw	D x1,y1,x2,y2 ··· xn,yn	xn: X axis (horizontal) coordinate yn: Y axis (vertical) coordinate	−32768.0000 to +32767.4999	2-6
E	Relative Circle	Er,θ1,θ2 (,θd)	r: Radius θ1: Start angle θ2: End angle θd: Resolution	r: −32768.0000 to +32767.4999 θ1,θ2: −32767° to +32767° θd: 1° to 179.9999°(5°)	2-7
G	A to + Circle	Gr,θ1,θ2 (,θd)	r: Radius θ1: Start angle θ2: End angle θd: Resolution	r: −32768.0000 to +32767.4999 θ1,θ2: −32767° to +32767° θd: 1° to 179.9999°(5°)	2-8
H	Home	H			2-10
I	Relative Draw	IΔx1,Δy1,Δx2,Δy2, ··· Δxn,Δyn	Δxn: X relative coordinates Δyn: Y relative coordinates	−32768.0000 to +32767.4999	2-10
J	Pen Change	Jn	n: Pen number	0 to 8 (1)	2-11
K	A to + %	Kn, ℓ 1, ℓ 2	n: Percentage with respect to 0% of the uppermost part ℓ 1: Distance of the end position from the center ℓ 2: Distance of the starting position from the center	n: −9101 to +9101 ℓ 1, ℓ 2: −32768.0000 to +32767.4999	2-12
L	Line Type	Lp	p=0: Solid line p=1,2: Dotted line p=3,4: Single dot dash line p=5: Double dot dash line	−5 to +5 (0)	2-15
M	Move	Mx1,y1,x2,y2,···Xn,Yn	x: X axis (horizontal) coordinate y: Y axis (vertical) coordinate	−32768.0000 to +32767.4999	2-18
N	Mark	Nn		1 to 15	2-19
P	Print	Pc1 c2 ··· cn	c1 to cn: Character string		2-20
Q	Alpha Rotate	Qn	n: Angle (90°)	0 to 3 (0)	2-21
R	Relative Move	RΔx1,Δy1,Δx2,Δy2,···ΔXn,ΔYn	Δxn: X relative coordinates Δyn: Y relative coordinates	−32768.0000 to +32767.4999	2-22
S	Alpha Scale	Sn	n: Character size	0 to 127 (3)	2-23
T	Hatching	Tn,x,y,d,t	n=1: Hatching only n=2: Rectangle only n=3: Hatched rectangle n=0: Hatched rectangle x,y: X axis and Y axis lengths d: Spacing between hatching t: Haching angle	n: 0 to 3 x,y,d: −32768.0000 to +32767.4999 t: 1 to 4 t: 1 (0°), 2 (45°), 3 (90°), 4 (135°)	2-24
X	Axis	Xp,q,r	p=0: Y axis p=1: X axis q: Scale spacing r: Number of repetitions	p: 0,1 q: −32768.0000 to +32767.4999 r: 1 to 32676.4999	2-27

Command		Format	Parameter		Parameter range (Default value)	Page
Y	Curve	Ym,x1,y1,x2,y2, ··· xn,yn	m=0: Open curved line	xn,yn: X and Y absolute coordinates	m: 0 to 3 xn,yn: −32768.0000 to +32767.4999	2-29
			m=1: Closed curved line			
			m=2: Open curved line	xn,yn: X and Y relative coordinates		
			m=3 Closed curved line			
_	Relative Curve	_m,Δx1,Δy1,Δx2,Δy2, ··· Δxn,Δyn	m=0: Open curved line m=1: Closed curved line Δxn: X relative coordinate Δyn: Y relative coordinate		m: 0 to 1 Δxn,Δyn: −32768.0000 to +32767.4999	2-31
^	Call RD-GL I Command	^ [RD-GL I command] [parameter] ··· (, [parameter]) [terminator(;)]				2-33

RD-GL I Commands

Command		Format	Parameter	Parameter range (Default value)	Page
AA	Arc Absolute	AAx,y,θc (,θd);	x: X center coordinates y: Y center coordinates θc: Center angle θd: Resolution	x,y: −32768.0000 to +32767.4999 θc: −32768.0000° to +32767.4999° θd: −32768.0000° to +32767.4999° (5)	3-16
AR	Arc Relative	ARΔx,Δy,θc (,θd);	Δx: X center coordinates Δy: Y center coordinates θc: Center angle θd: Resolution	Δx,Δy: −32768.0000 to +32767.4999 θc: −32768.0000° to +32767.4999° θd: −32768.0000° to +32767.4999° (5)	3-17
CA	Designate Alternate Character Set	CAn; CA;	n: Character set number	n: 0~4,6~9,30~39 (Designated by the DIP switch)	3-18
CI	Circle	CIr (,θd);	r: Radius θd: Resolution	r: −32768.0000 to +32767.4999 θd: −32768.0000° to +32767.4999° (5)	3-19
CP	Character Plot	CPnx,ny; CP;	nx: Number of characters in X direction ny: Number of characters in Y direction	nx: −128.0000 to +127.9999 ny: −128.0000 to +127.9999	3-20
CS	Designate Standard Character Set	CSn; CS;	n: Chracter set number	n; 0~4,6~9,30~39 (Designated by the DIP switch)	3-21
DC	Digitize Clear	DC;			3-22
DF	Default	DF;			3-23
DI	Absolute Direction	DIrun,rise; DI;	run=0: Vertical printing rise=0: Horizontal printing	−128.0000 to +127.9999 (run=1,rise=0)	3-24
DP	Digitize Point	DP;			3-25
DR	Relative Direction	DRrun,rise; DI;	run=0: Vertical printing rise=0: Horizontal printing	−128.0000 to +127.9999 (run=1,rise=0)	3-26
DT	Defined Terminator	DTc;	c: Character	Other than [NULL]CHR$(0) character [ETX]CHR$(3)	3-27
EA	Edge Rectangle Absolute	EAx,y;	x: X absolute coordinates y: Y absolute coordinates	−32768.0000 to +32767.4999	3-28
ER	Edge Rectangle Relative	ERΔx,Δy;	Δx: X relative coordinates Δy: Y relative coordinates	−32768.0000 to +32767.4999	3-29
EW	Edge Wedge	EWr,θ1,θc (,θd);	r: Radius θ1: Start angle θc: Center angle θd: Resolution	r: −32768.0000 to +32767.4999 θ1: −32768.0000° to +32767.4999° θC: −32768.0000° to +32767.4999° θd: −32768.0000° to +32767.4999° (5)	3-30
FT	Fill Type	FTn (,d (,θ)); FT;	n=1: Directional shading n=2: Unidirectional shading n=3: Hatching n=4: Cross hatching n=5: Ignored d: Spacing θ: Angle	n: 1 to 5 (1) d: 0 to 32767.4999 (d=(P1−P2)×0.01) θ: −32760° to +32760° (0)	3-32
IM	Input Mask	IME; IM;	E: Error mask value		3-33
IN	Initialize	IN;			3-34
IP	Input P1 and P2	IPP1x,P1y (,P2x,P2y);	X and Y coordinates of P1 and P2	Designated by the DIP switch	3-34

Command		Format	Parameter	Parameter range (Default value)	Page
IW	Input Window	IWx1,y1,x2,y2; IW;	x1 and y1 are coordinates of the lower left corner x2 and y2 are coordinates of the upper right corner	Designated by the DIP switch	3-36
LB	Label	LB c1 c2 c3··· Cn CHR$(3)	Cn: Character string		3-37
LT	Line Type	LTn,(p); LT;	n: pattern number p: pitch length (%)	n=−128 to +127 (Solid line) P=0 to 127.9999 (4)	3-38
OA	Output Actual Position	OA;			3-39
OC	Output Commanded Position	OC;			3-40
OD	Output Digitized	OD;			3-40
OE	Output Error	OE;			3-41
OF	Output Factors	OF;			3-42
OH	Output Hard Clip	OH;			3-42
OI	Output Identification	OI;			3-43
OO	Output Options	OO;			3-43
OP	Output P1 and P2	OP;			3-44
OS	Output Status	OS;			3-44
OW	Output Window	OW;			3-45
PA	Plot Absolut	PAx1,y1 (,x2,y2, ···); PA;	Absolute X and Y coordinates	−32768.0000 to +32767.4999	3-46
PU and PD	Pen Up/Down	PU; PD; PUx1,y1 (,x2,y2, ···); PDx1,y1 (,x2,y2, ···);	Absolute X and Y coordinates	−32768.0000 to +32767.4999	3-48
PR	Plot Relative	PRΔx1,Δy1 (,Δx2,Δy2,···); PR;	Absolute X and Y coordinates	−32768.0000 to +32767.4999	3-49
PS	Paper Size	PSs;	s: Paper size	0 to 127 Designated by the DIP switch	3-50
PT	Pen Thickness	PTd; PT;	d: Pen thickness (mm)	0.1 to 5.0 (0.3)	3-50
RA	Rectangle Absolute	PAx,y;	x: X absolute coordinates y: Y absolute coordinates	−32768.0000 to +32767.4999	3-51
RO	Rotate Coordinate	ROn; RO;	n: Rotate angle	0° or 90° (0)	3-52
RR	Rectangle Relative	RRΔx,Δy;	Δx: X relative coordinates Δy: Y relative coordinates	−32768.0000 to +32767.4999	3-54
SA	Select Alternate	SA;			3-55
SC	Scale	SCxmin,xmax,ymin,ymax; SC;	xmin,ymin: P1 user coordinates xmax,ymax: P2 user coordinates	−32768.0000 to +32767.4999 (Depends on the DIP switch setting of the paper size mode.)	3-55
SI	Absolute Character Size	SIw,h; SI;	w: Character width (cm) h: Character height (cm)	−128.0000 to +127.9999 (cm) (B/A3 size: w=0.29,h=0.38) (A/A4 size: w=0.19,h=0.27)	3-56
SL	Slant	SLtanθ; SL;	tanθ: Character slant	−128.0000 to +127.9999 (0)	3-57
SM	Symbol Mode	SMk; SM;	k: Character or symbol	(no symbol mode)	3-58
SP	Select Pen	SPn; SP;	n: Pen number	n=0 to 8 (0)	3-60
SR	Relative Character Size	SRw,h; SR;	w: Character width h: Character height	−128.0000 to +127.9999 (%) (w=0.75,h=1.5)	3-61

Command		Format	Parameter	Parameter range (Default value)	Page
SS	Select Standard	SS;			3-62
TL	Tick Length	TLtp (,tn); TL;	tp: Tick length in positive direction tn: Tick length in negative direction	−128.0000 to +127.9999 (tp=0.5,tn=0.5)	3-62
UC	User Defined Character	UC (P,)Δx1,Δy1, ··· (P,) Δxn,Δyn; UC;	Δxn: Number of X grids Δyn: Number of Y grids	−128.0000 to +127.9999	3-64
VS	Velecity Select	VSs; VS;	s: Pen speed (cm/sec)	0 to 127.9999 (42)	3-65
WG	Shade Wedge	WGr,θ1,θc (,θd);	r: Radius θ1: Start angle θc: Center angle θd: Resolution	r: −32768.0000 to +32767.49999 θ1: −32768.0000° to +32767.49999 θc: −32768.0000° to +32767.49999° θd: −32768.0000° to +32767.49999° (5)	3-66
XT and YT	Tick	XT; YT;			3-68

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