

4636-UM-152

PERSONAL PLOTTER

**WX4636/4636R
WX4637/4637R
WX4638/4638R**

**INSTRUCTION MANUAL
(WITH TABLES OF TEST RESULTS)**

GRAPHTEC CORP.

TOKYO, JAPAN

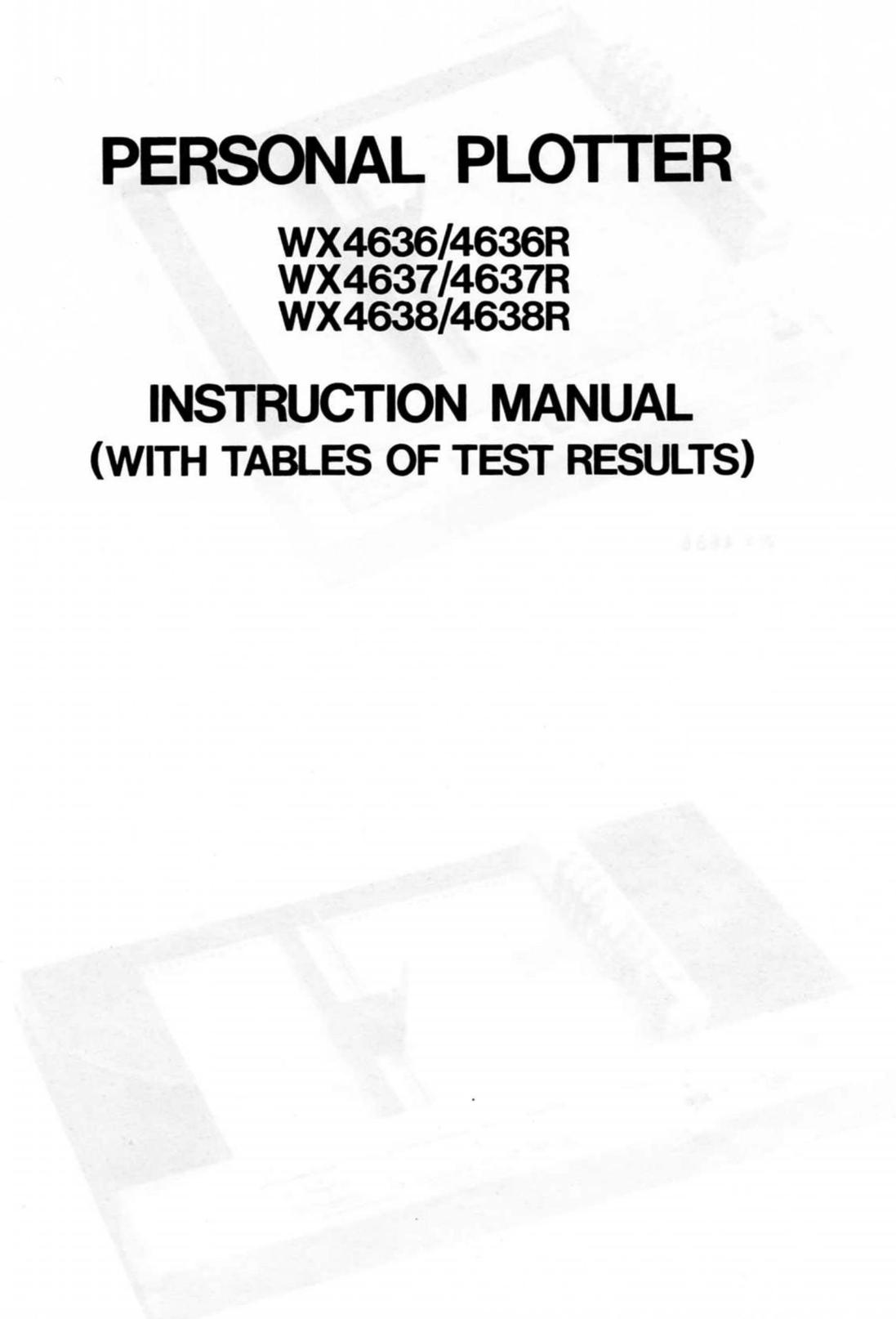
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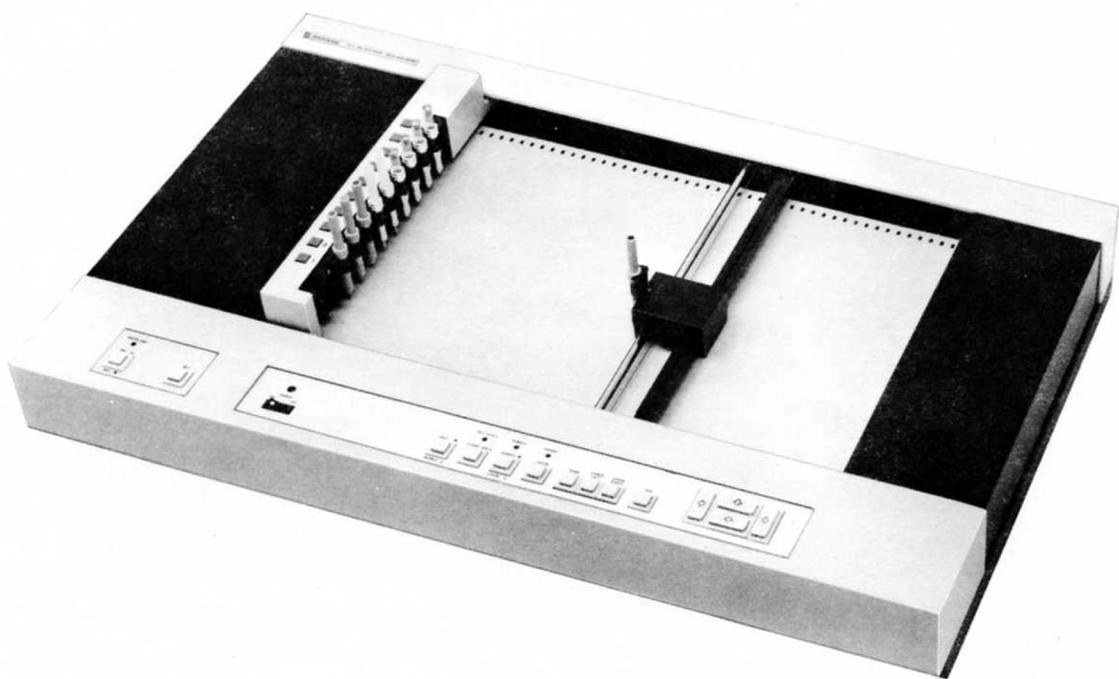
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WX 4636 (R)



WX 4636

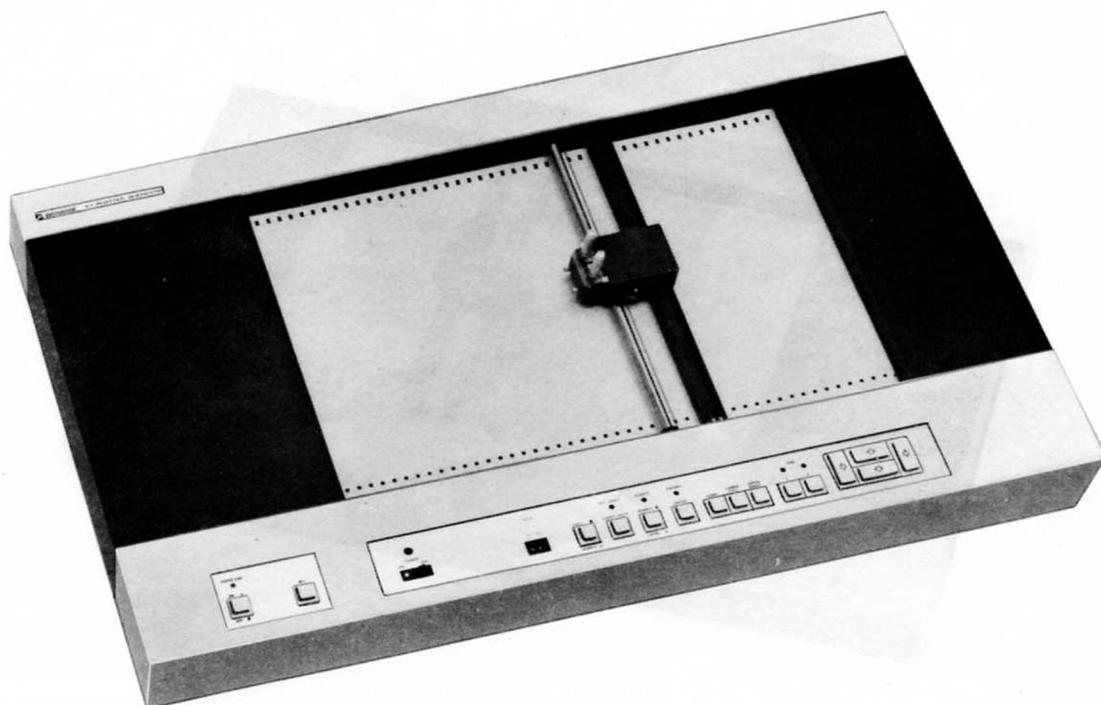


WX 4636 R

WX 4637 (R)



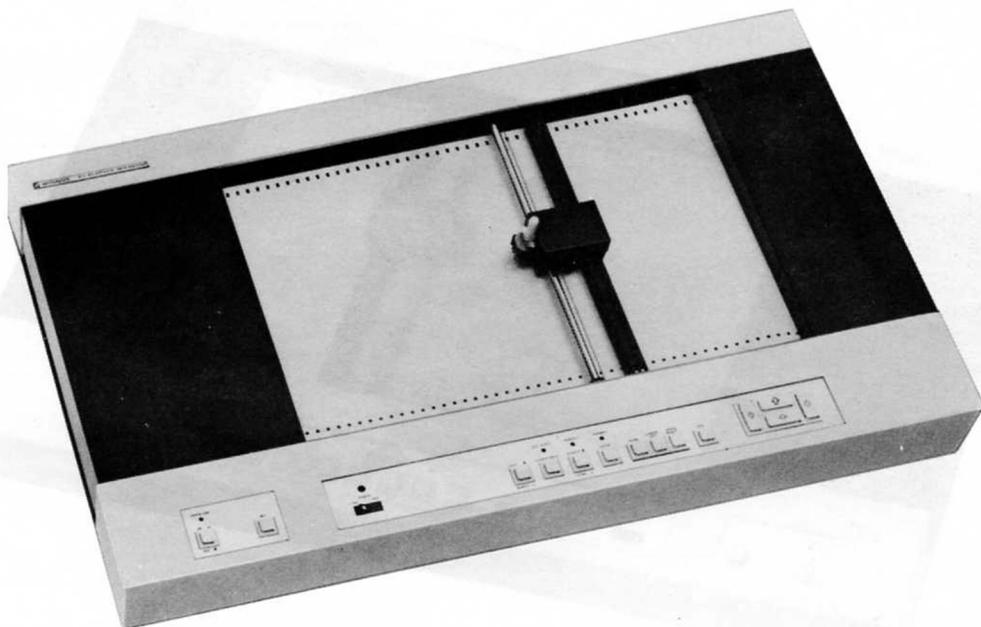
WX 4637



WX 4637 R



WX 4638



WX 4638 R

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1. OVERVIEW

1.1 Outline of WX4636(R), WX4637(R), WX4638(R)

These models are compact flat-bed type plotter with intelligent functions which is easily and directly compatible with digital control equipment with a standard interface such as GP-IB, RS-232C, or 8 bit parallel, and is able to plot drawings based on data from them.

Modular mechanical and electrical parts incorporating a microcomputer and a fully digitized inner control such as a pulse pen drive provides a higher reliability and easier maintenance compared with the DC servo drive method which partly relies on analog technology. The pulse motor is micro-step driven and gives smooth and precise drawing.

These models are suited for the drawing of all types of graphs, the formation of statistical charts, the engineering and construction of NC tape check monitors and for computer art, etc.

The different varieties of Watanabe plotters are as follows:

WX4636(R) Multipen (10 pens) flat-bed type
WX4637(R) 2-pen flat-bed type
WX4638(R) 1-pen flat-bed type
(R indicates the models with built-in paper feed mechanism.)

1.2 Special Characteristics of WX4636(R), WX4637(R), WX4638(R)

- o High speed drawing (max. 400 mm/s. in direction of axis).
- o Automatic selection from 10 pens. (WX4636(R))
- o A buffer of 1.6 Kbyte is incorporated to reduce the computer's load.
- o Intelligent functions are built-in to facilitate plotting by simple commands.

Examples:

- o Various styles of characters can be drawn (ASCII letters, Greek letters, Katakana, etc.)
- o Various types of lines can be drawn (Solid, dotted or broken lines)
- o Circles, arcs and cubic interpolation curves can be drawn.
- o The pen speed can be specified.
- o Type of pen can be selected.
- o Self test and interface modes facilitate functional self-checking.
- o The recording paper can be fixed instantly by the static electricity absorption method.
- o 4 - 8 colors each of various types of pen are available (water and oil based ball-point pens, water and oil based fiber-tip pens, or ink pen)
- o 3 kinds of interface are available: GP-IB, RS-232C or 8 bit parallel.
- o Automatic pen-exchange facility is available (up to 10 pens in the WX4636(R) and 2 pens in the WX4637(R)).
- o The recording paper is fed automatically (only in the models with a paper feed mechanism (R)).

1.3 General Specifications

1.3.1 Hardware specifications of WX4636(R)

Type number	WX4636 (A3 size flat-bed type)	WX4636R (WX4636 with paper take up adaptor)
Plotting area	X-axis: 381mm(15 in.), Y-axis: 254mm(10 in.)	
Plotting speed	Max. 400mm/sec. (per axis)	
Roll chart feed speed		50mm/sec.
Programmable step size	X, Y axis: 0.1mm	
Quantity of roll chart feed		0.1mm
Distance accuracy	Less than $\pm 0.2\%$ of moving distance	
Repeatability	Less than 0.15mm	
Dynamic accuracy	Less than ± 0.1 mm (P-P 0.2mm)	
Perpendicular accuracy	Less than 0.3mm/250mm	
Distance accuracy of roll chart feed		Less than $\pm 0.5\%$
Snaking of roll chart feed		Less than 0.4mm/500mm
Number of pens	10	
Pen type	Ball-point pen, Fiber tipped pen, Ink pen	
Pen color (color of ink)	Ball-point pen: 4 colors (black, red, blue, green) Fiber tipped pen: 8 colors (black, red, violet, brown, blue, green, orange, pink) Ink pen: 4 colors (0.2 ϕ , 0.3 ϕ , 0.4 ϕ , 0.5 ϕ , 0.6 ϕ , 0.8 ϕ)	
Pen response speed	12 times/sec. (up-down operation)	
Pen change-over accuracy	Less than 0.2mm	
Chart paper	Leaf paper: 4 kinds	Roll paper: 2 kinds
Method of holding chart paper	Static electricity absorption method	Back tension method
Power supply conditions	100 V series: 100, 110, 117V (A.C.) 200 V series: 200, 220, 240V (A.C.)	
Power supply tolerance	$\pm 10\%$	
Power consumption	Less than 140 VA	Less than 165 VA
Operating temperature range	+5 ~ +40°C	
Operating humidity range	35 ~ 75% (R.H.)	
Dimensions	513(W) x 480(D) x 152(H)mm	790(W) x 480(D) x 152(H)mm
Weight	18Kg	28Kg

1.3.2 Hardware specifications of WX4637(R)

Type number	WX4637 (A3 size flat-bed type)	WX4637R (WX4637 with paper take up adaptor)
Plotting area	1 pen setting X-axis: 381mm(15 in.), Y-axis: 254mm(10 in.)	2 pen setting X-axis: 381mm, Y-axis: 230mm
Plotting speed	Max. 400mm/sec. (per axis)	
Roll chart feed speed		50mm/sec.
Programmable step size	X, Y axis: 0.1mm	
Quantity of roll chart feed		0.1mm
Distance accuracy	Less than $\pm 0.2\%$ of moving distance	
Repeatability	Less than 0.15mm	
Dynamic accuracy	Less than ± 0.1 mm (P-P 0.2mm)	
Perpendicular accuracy	Less than 0.3mm/250mm	
Distance accuracy of roll chart feed		Less than $\pm 0.5\%$
Snaking of roll chart feed		Less than 0.4mm/500mm
Number of pens	2	
Pen type	Ball-point pen, Fiber tipped pen, Ink pen	
Pen color (color of ink)	Ball-point pen: 4 colors (black, red, blue, green) Fiber tipped pen: 8 colors (black, red, violet, brown, blue, green, orange, pink) Ink pen: 4 colors (0.2 ϕ , 0.3 ϕ , 0.4 ϕ , 0.5 ϕ , 0.6 ϕ , 0.8 ϕ)	
Pen response speed	12 times/sec. (up-down operation)	
Pen change-over accuracy	Less than 0.3mm	
Chart paper	Leaf paper: 4 kinds	Roll paper: 2 kinds
Method of holding chart paper	Static electricity absorption method	Back tension method
Power supply conditions	100 V series: 100, 110, 117V (A.C.) 200 V series: 200, 220, 240V (A.C.)	
Power supply tolerance	$\pm 10\%$	
Power consumption	Less than 140 VA	Less than 165 VA
Operating temperature range	+5 ~ +40°C	
Operating humidity range	35 ~ 75% (R.H.)	
Dimensions	500(W) x 480(D) x 131(H)mm	790(W) x 480(D) x 131(H)mm
Weight	17Kg	27Kg

1.3.3 Hardware specifications of WX 4638(R)

Type number	WX4638 (A3 size flat-bed type)	WX4638R (WX4638 with paper take) up adaptor
Plotting area	X-axis: 381mm(15 in.), Y-axis: 254mm(10 in.)	
Plotting speed	Max. 400mm/sec. (per axis)	
Roll chart feed speed		50mm/sec.
Programmable step size	X, Y axis: 0.1mm	
Quantity of roll chart feed		0.1mm
Distance accuracy	Less than $\pm 0.2\%$ of moving distance	
Repeatability	Less than 0.15mm	
Dynamic accuracy	Less than $\pm 0.1\text{mm}$ (P-P 0.2mm)	
Perpendicular accuracy	Less than 0.3mm/250mm	
Distance accuracy of roll chart feed		Less than $\pm 0.5\%$
Snaking of roll chart feed		Less than 0.4mm/500mm
Number of pens	1	
Pen type	Ball-point pen, Fiber tipped pen, Ink pen	
Pen color (color of ink)	Ball-point pen: 4 colors (black, red, blue, green) Fiber tipped pen: 8 colors (black, red, violet, brown, blue, green, orange, pink) Ink pen: 4 colors (0.2 ϕ , 0.3 ϕ , 0.4 ϕ , 0.5 ϕ , 0.6 ϕ , 0.8 ϕ)	
Pen response speed	12 times/sec. (up-down operation)	
Chart paper	Leaf paper: 4 kinds	Roll paper: 2 kinds
Method of holding chart paper	Static electricity absorption method	Back tension method
Power supply conditions	100 V series: 100, 110, 117V (A.C.) 200 V series: 200, 220, 240V (A.C.)	
Power supply tolerance	$\pm 10\%$	
Power consumption	Less than 140 VA	Less than 165 VA
Operating temperature range	+5 ~ +40° C	
Operating humidity range	35 ~ 75% (R.H.)	
Dimensions	500(W) x 480(D) x 131(H)mm	790(W) x 480(D) x 131(H)mm
Weight	17Kg	27Kg

1.3.4 Interface Specifications

GP-IB	Functions	SH : SH-1	RL : RL-1
		AH : AH-1	PP : PP-1
		T : T-6	DC : DC-1
		L : L-3	DT : DT-0
		SR : SR-1	C : C-0

Data format

- o ASCII format (numerical data is represented in decimals as ASCII characters.)
- o 2-byte format (numerical data is handled as 2-byte binary numbers).

Connector used: 57-20240 (plotter side)

RS-232-C

Functions

- o Data transmission:
Start-stop synchronization, semi duplex and duplex
- o Data transmission speed:
75, 110, 150, 300, 600, 1200, 2400, 4800, 9600 baud (selection by switch)
- o Stop bit
1, 1½, 2 (selection by switch)
- o Parity:
Even, odd, none (selection by switch)
- o Data length:
7 bit, 8 bit (selection by switch)

Data format

- o ASCII format (numerical data is represented in decimals as ASCII characters)
- o 2-byte format (numerical data is handled as 2-byte binary numbers)

Connector used: DB-25S (plotter side)

8 bit parallel

Signal format

Input signal

Semi ASCII code or JIS 8 code (8 bit parallel)
STROBE (1 bit)

Output signal

BUSY (1 bit), $\overline{\text{BUSY}}$ (1 bit), $\overline{\text{ACK}}$ (1 bit), $\overline{\text{ERROR}}$ (1 bit)

Signal level

TTL level

LOW = "0" (0 - 0.4 V)

HIGH = "1" (2.4 V - 5.5 V)

Others

The input data is non-synchronous and should be maintained from the time STROBE is input to the time $\overline{\text{ACK}}$ is output.

1.3.5 Programmable Function Commands (42)

- o Related to the control of the plotter (10)
CLEAR, HOME, OFFSET, NEWPEN, CHART FEED, SPEED,
FACTOR, WRITE LOWER LEFT, WRITE UPPER RIGHT,
PROMPT LIGHT.
- o Related to the plotting of characters and symbols (10)
FONT, ALPHA SCALE, ALPHA SPACE, ALPHA ROTATE,
ALPHA ITALIC, ALPHA RESET, PRINT, KANA (GREEK),
MARK, USER'S PATTERN.
- o Related to straight line plotting (movement) (6)
LINE TYPE, LINE SCALE, DRAW, RELATIVE DRAW, MOVE,
RELATIVE MOVE.
- o Related to graph plotting (2)
AXIS, HATCHING.
- o Related to the plotting of curves and circles (4)
CIRCLE, RELATIVE CIRCLE, CURVE, RELATIVE CURVE.
- o Related to the read-out of coordinate values (5)
GIN, CALL GIN, READ LOWER LEFT, READ UPPER RIGHT,
READ OFFSET.
- o Related to the interface control (6)
INTERFACE CLEAR, TERM, READ STATUS WORD 1, READ
STATUS WORD 2, READ STATUS WORD 3, ERROR MASK.

Note: CLEAR, INTERFACE CLEAR and READ commands cannot be used in the 8bit parallel interface.

1.4 Standard Accessories

Model	WX4636	WX4636R	WX4637	WX4637R	WX4638	WX4638R
1. Plastic cover	1	1	1	1	1	1
2. Power supply cable(2m)	1	1	1	1	1	1
3. Spare fuse 100V series: 2A 200V series: 1A	1	1	1	1	1	1
4. Fiber-tip pen (water based)	KF520-F6 red,black,violet,brown,blue,green				KF522-BK(black) 5 5	
5. Ball-point pen (Oil based)	KB100-S1 2black,1each of red, blue, and green				KB102-BK(black) 5 5	
6. Ball-point pen plungers	PHP-18-BALL 4		PHP-20-BALL 2		PHP-20-BALL 1	
7. Recording paper PL501 (leaf paper)	50 sheets	/	50 sheets	/	50 sheets	/
8. Recording paper PR505 (roll paper 13m)	/	1 roll	/	1 roll	/	1 roll
9. Take-up roller	/	1	/	1	/	1
10. Interface connector DB-25P (only RS-232-C)	1	1	1	1	1	1
11. Interface connector FCN-361J016-AG (only 8bits parallel)	1	1	1	1	1	1
12. Instruction manual	1	1	1	1	1	1

2. CHECKS AND INSTALLATION

2.1 Unpacking

Check that there is no abnormality in the condition of the package (e. g. shock or water damage).

2.2 Checks

Inspect the appearance and number of accessories.

2.3 Installation Conditions

Being designed as a desk type plotter, this model should be used, as a rule, in the horizontal position.

2.4 Setting of the Power Supply Selector

Set the power supply voltage. The voltage selector is located on the base of the plotter. This plotter comes in 2 versions, the 100 V series (100 V, 110 V, 117 V) and the 200 V series (200 V, 220 V, 240 V). The voltage is set at 100 V in the former series and at 200 V in the latter. A label stuck near the AC connector on the rear panel of the plotter indicates the type of power supply. (100 V series or 200 V series.)

Note:

- o Be sure to disconnect the power supply cord before switching over the voltage selector.
- o Use a 2A fuse for the 100 V series.
- o Use a 1A fuse for the 200 V series.

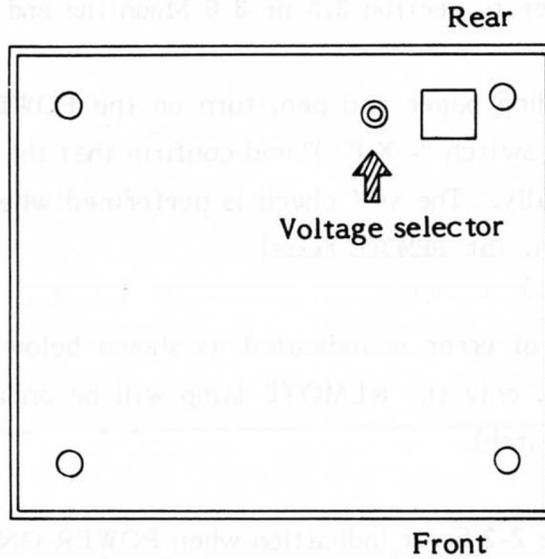


Fig. 2-1 Base drawing

The voltage selector is set as follows:

Table 2-1 Selector setting

Selection point	100 V series	200 V series
	100 V AC	200 V AC
	110 V AC	220 V AC
	117 V AC	240 V AC

2.5 Inspection of the Operation Panel

Turn off the POWER and connect the power supply cord. Turn on the POWER and check the functions of the operation panel switches (refer to section 3-1 Operation Panel in this manual).

2.6 Self Test (refer to section 3.5 or 3.6 Mounting and removal of pens)

Fix the recording paper and pen, turn on the POWER while holding down the POSITION switch "- X (⇐)" and confirm that the self test pattern is drawn automatically. The self check is performed whenever the power supply is switched on. (at REMOTE mode)

The presence of error is indicated as shown below. If there is no error in the plotter, only the REMOTE lamp will be on and the check is complete (by R/L switch).

Table 2-2 Error indication when POWER ON

PROMPT lamp	REMOTE lamp flashing	OFF SCALE lamp flashing
Off	CPU RAM error	CPU ROM error
Flashing	Interface RAM error	Interface ROM error
On	Interface transfer error	CPU to interface transfer error

Notes:

- o In the self check activated by switching the power on, the following points are checked: the ROM and RAM of the interface and CPU respectively and the data transfer between the interface and CPU.
- o If both lamps flash in this check (activated by switching the power on), they flash simultaneously.

2.7 Others

Though a noise filter is incorporated in the plotter, the use of an additional noise filter is recommended when there is much noise on the AC power supply line. The capacity of the filter should be 3A or more.

3. OPERATION

3.1 Operation Panel

3.1.1 Plotter Operation Panel

The following Fig. 3-1 shows the operation panel of the plotter WX4636(R).

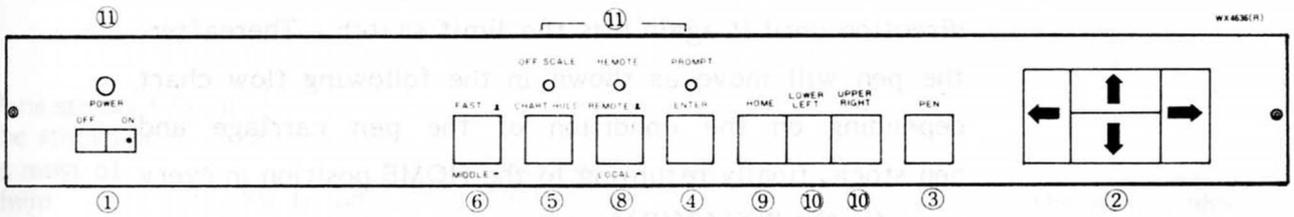


Fig. 3-1 Operation panel of the plotter WX4636(R)

The following Fig. 3-2 shows the operation panel of the plotter WX4637(R).

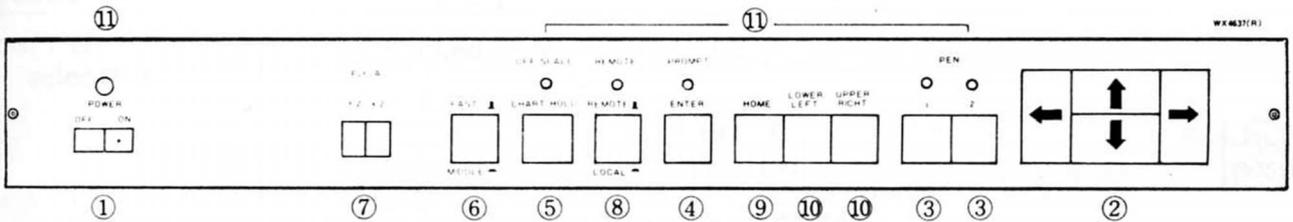


Fig. 3-2 Operation panel of the plotter WX4637(R)

The following Fig. 3-3 shows the operation panel of the plotter WX4638(R).

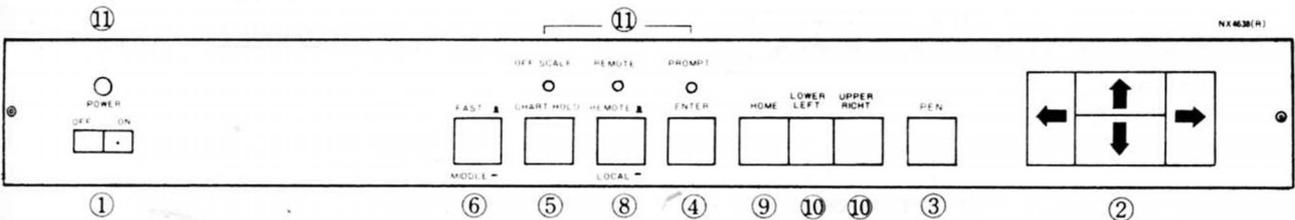


Fig. 3-3 Operation panel of the plotter WX4638(R)

(1) Power switch: seesaw switch

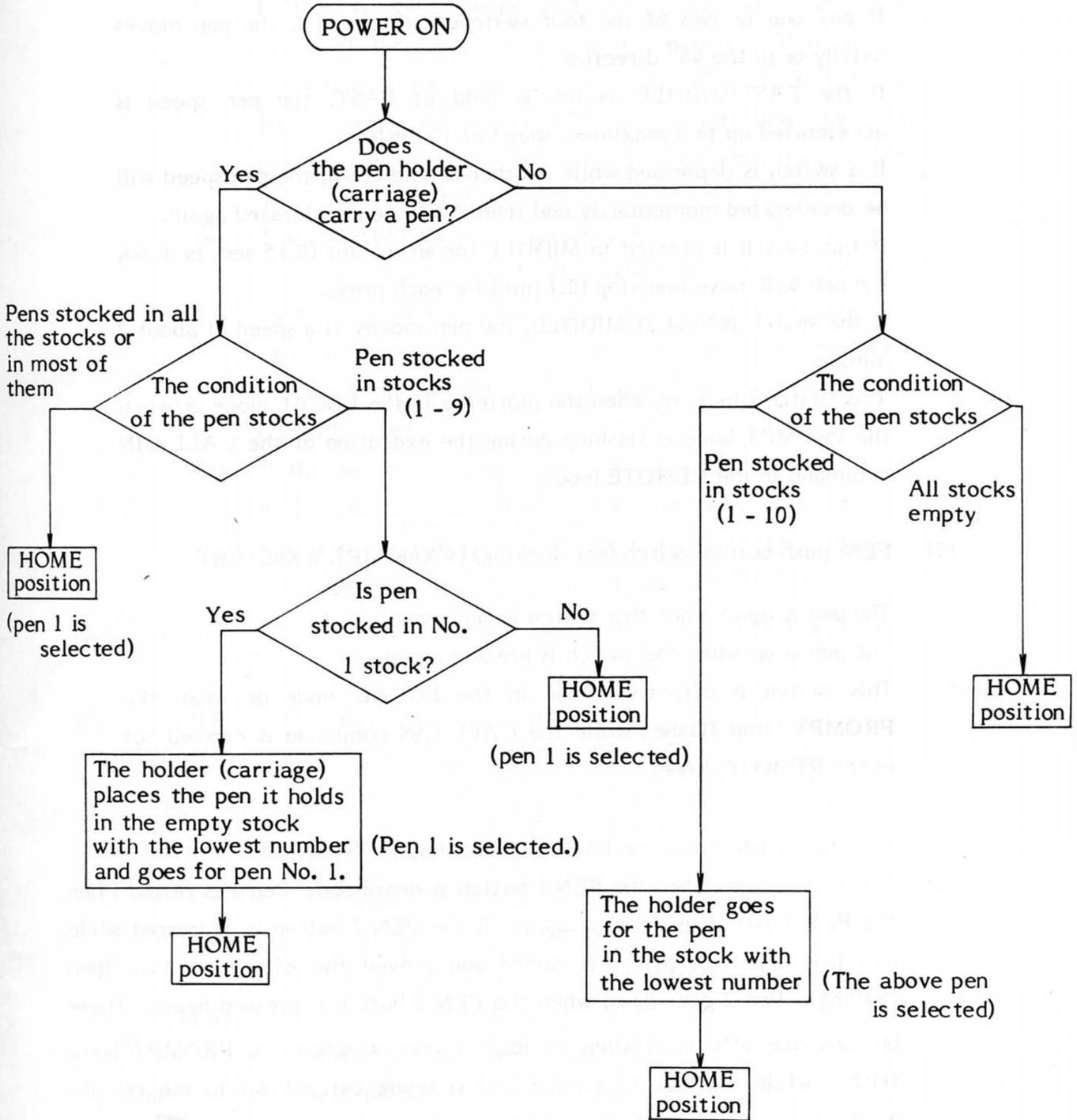
Power is on when the side marked "." of this switch is down.

When the power is turned on:

- (a) The POWER lamp (red) comes on.
- (b) The pen moves 15 mm in the direction of + X, - Y (as seen from the operation panel). Then it goes on in the - Y direction until it hits the limit switch and then in the + X direction until it again hits the limit switch. Thereafter, the pen will move as shown in the following flow chart depending on the condition of the pen carriage and pen stock, finally returning to the HOME position in every case. (In the WX4636(R).)
- (c) The pen moves to the mechanical origin at the lower left corner (with respect to the control panel) and then stops at the HOME position. (In the WX4637(R) or WX4638(R).)



Pen movement during POWER ON initialization (WX4636(R))



(2) POSITION: push button switches (non-locking)

There is a switch for each of the 4 directions.

If any one or two of the four switches are pressed, the pen moves axially or in the 45° direction.

If the FAST/MIDDLE switch is held at FAST, the pen speed is accelerated up to a maximum speed of 10 cm/sec.

If a switch is depressed while another is held down, the pen speed will be decelerated momentarily and then it will be accelerated again.

If this switch is pressed to MIDDLE for an instant (0.15 sec. or less), the pen will move one stop (0.1 mm) for each press.

If the switch is held at MIDDLE, the pen moves at a speed of about 2 mm/sec.

This switch functions when the plotter is in the LOCAL mode or when the PROMPT lamp is flashing during the execution of the CALL GIN command in the REMOTE mode.

(3) PEN: push button switch (non-locking) (WX4636(R), WX4638(R))

The pen is down when this switch is depressed.

The pen is up when the switch is pressed again.

This switch is effective when in the LOCAL mode or when the PROMPT lamp flashes while the CALL GIN command is carried out in the REMOTE mode.

PEN 1, 2: push-button switches (non-locking) (WX4637(R))

Pen 1 goes down when the PEN 1 button is depressed. Pen 1 is raised when the PEN 1 button is pressed again. If the PEN 2 button is depressed while pen 1 is selected, pen 1 is raised and moved the offset distance (pen spacing). Pen 2 goes down when the PEN 2 button is pressed again. These buttons are effective when in local mode or when the PROMPT lamp flashes while a CALL GIN command is being carried out in the remote mode. Pen 1 is selected when the power is turned on.

(4) ENTER: push button switch (non-locking)

This switch has 3 functions:

- (a) If this switch is depressed in the LOCAL mode, the PROMPT lamp flashes, the plotting area is determined according to the operation of the LOWER LEFT, UPPER RIGHT switches (to be described later) and the pen position is selected. The lamp comes on when the plotting area is set. (PROMPT lamp)
- (b) The PROMPT lamp flashes when the CALL GIN command is received in the REMOTE mode. At this time, if this switch is held down, transfer of the actual position of the pen and the pen condition to the external controller takes place. When transfer is complete, the lamp goes off. (PROMPT lamp)
- (c) If this switch is depressed along with switch +Y or - Y, it will have the same effect as the turning on of the power (the operation described in the above (1) POWER switch (b), (c) will take place). (Refer to section 3-3.)

Note: In (c) above, release the + Y or - Y switch before pressing the ENTER switch.

(5) CHART HOLD: push button switch (lockable)

If this switch is pressed, the recording paper is fixed to the writing panel (static electricity adsorption board). When the switch is released, the adsorption is switched off.

(6) FAST/MIDDLE: push button switch (lockable)

This switch specifies the maximum plotting speed.

The maximum plotting speed in the axial direction is 40 cm/sec. on FAST and 20 cm/sec. on MIDDLE.

The maximum speed of movement when the pen is up is 40 cm/sec. both on FAST and MIDDLE.

If this switch is turned during plotting, the plotting speed changes accordingly after the current vector plot.

This is the case too when in LOCAL mode.

(7) P.F.A. (Pen Fine Adjustment): rotary switches (WX4637(R))

These switches are used for the compensation of the spacing between the two pens. The pen spacing is as shown in Fig. 3-4.

Table 3-1 P.F.A

Switch indication of X2, Y2	Function
0	(Note)
1	-0.4mm compensation
2	-0.3mm
3	-0.2mm
4	-0.1mm
5	0mm
6	+0.1mm
7	+0.2mm
8	+0.3mm
9	+0.4mm

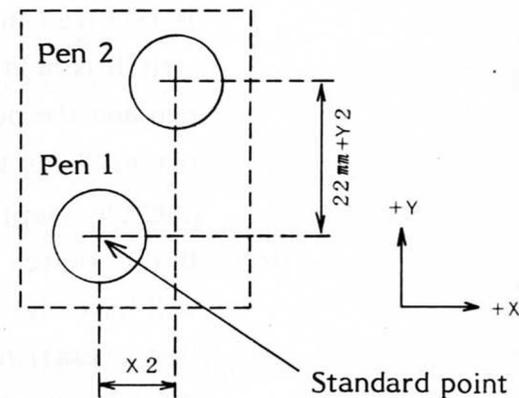


Fig. 3-4 Pen spacing

(8) REMOTE  / LOCAL : push-button switch (non-locking)

The switch changes the plotter's mode of operation. When depressed, plotter is in Local mode; when pushed again, in REMOTE mode.

When in the REMOTE mode, the plotter operates according to data from external equipment. When in the LOCAL mode, the potter accepts data from the external equipment and stores it in the buffer (until the buffer is full) without plotting it.

If plotter is switched over from REMOTE mode to LOCAL mode, after the current command is obeyed, plotting will stop.

(9) HOME: push button switch (non-locking)

If this switch is held down, the pen is raised and returned to the HOME position. The switch is effective when in LOCAL mode or when the PROMPT lamp flashes while a CALL GIN command is being carried out in the REMOTE mode.

- (10) LOWER LEFT: push button switch (non-locking)
UPPER RIGHT: push button switch (non-locking)

These are used to specify the plotting area (to adjust to the size of the recording paper or other conditions). Effective only when in LOCAL mode.

- (a) If either of these is depressed immediately after the ENTER switch (while the PROMPT lamp is flashing), the pen position currently selected is specified as the LOWER LEFT or UPPER RIGHT corner.

The plotting area is specified in this way.

Once the the plotting area is specified, the plotter will not draw outside the valid plotting area even if such plotting is commanded. Instead, the OFF SCALE status of the corresponding direction becomes "1".

- (b) If one of these switches is pressed when the ENTER switch isn't held down, the pen will move to the already specified LOWER LEFT or UPPER RIGHT corner.

This is very convenient for checking the plotting area.

If not specified, the LOWER LEFT and UPPER RIGHT corners will be set at the HOME position and the point $X = 3810$, $Y = 2540$ respectively.

(11) Display lamps

- (a) POWER (red LED)

Comes on with power. Monitors the power supply.

- (b) OFF SCALE (red LED)

Comes on when a command specifies plotting outside the valid plotting area defined by the coordinates of the LOWER LEFT and UPPER RIGHT corners.

(Flashes when input value overflows or FACTOR exceeds 2^{14} .

It turns off when the pen returns to the valid plotting area.)

- (c) PROMPT (red LED)

Comes on or flashes under the following conditions:

- o CALL GIN command flashes when received.
- o PROMPT LIGHT command comes on when $n = 1$ received.

- (d) REMOTE (red LED)

Indicates the plotter is in the REMOTE mode.

- (e) Pen 1, 2: Green LED (WX4637(R))

The LED corresponding to the number of the pen selected goes on.

Note: In the REMOTE mode, when the OFF SCALE lamp and the PROMPT lamp are both flashing, there is a command error.

In this case, the error is cleared by pressing the ENTER switch and the operation can continue.

If a CHART FEED command is received when there is no recording paper feed mechanism, or when there is a paper feed mechanism but the paper is exhausted, the R/L and PROMPT lamps will flash. This is cleared by pressing the ENTER switch.

3.1.2 Paper Feed Control Panel

The control panel of the paper feed mechanism is as shown below.

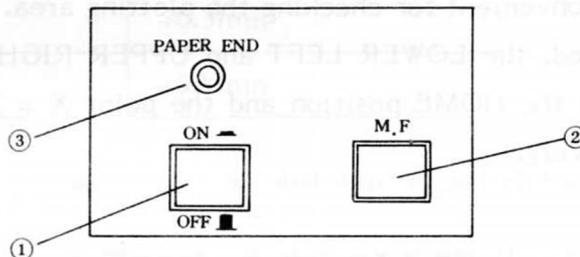


Fig. 3-5 Control panel of the paper feed mechanism

- (1) PAPER END switch: push button-switch (lockable)

This prevents the plotter from operating when there is no recording paper on the writing panel.

If the switch is turned ON, a detector will work lighting up the PAPER END lamp and outputting an alarm signal when the paper in the stock becomes less than 1 m (approximately). In such a case, renew the recording paper. If the switch is turned OFF, the PAPER END lamp will go out and the alarm signal won't be output. Keep the switch OFF when leaf paper is used, or when it is not necessary to know about the remaining 1 m of paper.

- (2) M. F switch: push button switch (non-locking)

If this is depressed when the plotter is in the LOCAL mode, recording paper is fed. Feeding continues as long as the button is depressed.

- (3) PAPER END lamp (red)

Comes on when the remaining recording paper is about 1 m. Doesn't light when the PAPER END switch is OFF.

ATTENTION:

When rolls of recording paper are used, do not press the CHART HOLD switch on the control panel of the plotter. Paper feed mechanism won't work while this switch is down.

3.1.3 Multipen Operation Panel (WX4636(R))

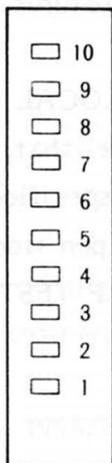


Fig. 3-6 Multipen operation panel

No. 1 pen selection switch - No. 10 pen selection switch: button switches (non-locking)

These are effective when in the local mode only.

- (A) All of the 10 selection switches are ignored in the following 2 cases:
- A - 1 There are pens in the pen holder and all the pen stocks.
 - A - 2 The pen holder and the pen stocks are all empty.
- (B) A pen selection switch is ignored if there is no pen in the corresponding pen stock. If the corresponding pen has already been selected (and is held by pen holder), the holder returns the pen to the stock.
- (C) If a selection switch is pressed and the corresponding pen is in the stock, the pen holder returns the pen it currently holds to its stock and picks up the pen selected by the switch from its stock. If the pen holder doesn't hold a pen at that time, it moves first to an empty stock and thereafter goes for the selected pen.

Notes:

- o After the change-over of pens, the pen holder returns to the position it was in previously.
- o If the pens are changed over when in the LOCAL mode and the plotter is switched to REMOTE mode after that, plotting will continue with the same pen unless a new one is specified.
- o If there is no pen in the pen holder nor in the pen stocks, the holder will move without a pen (only when in the SELF TEST and REMOTE modes).

WARNING:

The attachment of pens to the pen holder should be done only when the power to the plotter is switched off.

3.2 Self Check Tests

The following self check tests are provided by holding down the POSITION switches when the power is turned on.

The combined use of these switches allows self checking as shown in the following table.

Kind of test	POSITION switch to be held down when switching power on.
Normal status	None
Self test	- X 
Interface test 2	- Y 
Interface test 1	+ Y 

Table 3-2 Self check tests

3.2.1 Self Test

This test confirms the two main functions of the plotter: the internal controller and the pen drive mechanism.

When the POSITION switches are set for self test and the plotter is initialized, 11 radial lines are drawn at angles of 9° to each other as shown below.

Drawing is interrupted when the plotter is switched to the LOCAL mode from REMOTE. It restarts when the plotter returns to the REMOTE mode again.

*** TEST OF PLOTTER ***

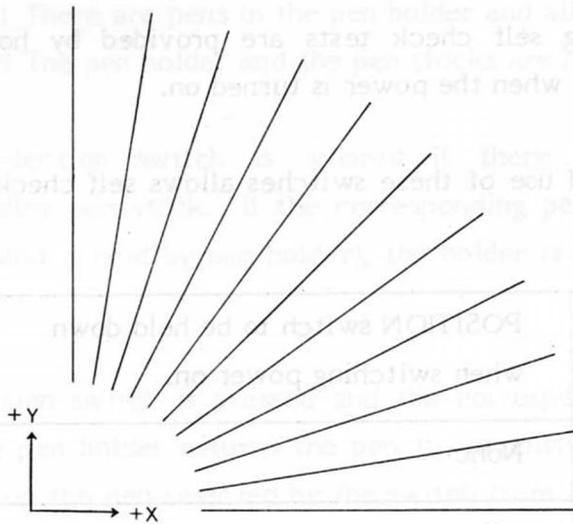


Fig. 3-7 Self test pattern

3.2.2 Interface Test 1

This test confirms the correct transmission of data.

If the POSITION switches are set for this test, the plotter is initialized and data is sent in the REMOTE mode, the data is plotted as follows in hexadecimal.

When READ STATUS WORD 1, 2 commands are sent, data regarding buffer control is output as usual but error data is not output. When other plotter output commands are sent, dummy data is output, so make sure that the processing sequence is not influenced by this output.

3.2.3 Interface Test 2

If the POSITION switches are set for this test, the plotter initialized and data is sent in the REMOTE mode to the plotter, the data is plotted as follows in ASCII coded letters.

The letters following the KANA command are written in kana characters and letters not included in the code chart are plotted in hexadecimal numbers of 2 digits.

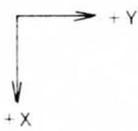
The parity bit of the data is always converted to 0 (handled as 0), so use interface test 1 when sending data in binary data format using a GP-IB interface.

When READ STATUS WORD 1, 3 commands are given, buffer control data is output as usual but error data is not output. Dummy data is output for other plotter output commands, so make sure that the processing sequence is not influenced by this output.

```

AM400,200,X1,100,17,M400,200,X0,200,7,M500,200,X0,200,7,M600,200,X0,200,7,S2
S,Q20,M          575.00          150.0000 OR P 000 OR 03 M 675 15000
OR P 200 OR 03 M 775 15000 OR P 400 OR 03 M 875 15000 OR P 600 OR 03
M 975 15000 OR P 800 OR 03 M 1083 15000 OR P1000 OR 03 M 1183 15000
OR P1200 OR 03 M 1283 15000 OR P1400 OR 03 M 1383 15000 OR P1600 OR 03
M 1483 15000 OR P1800 OR 03 M 1583 15000 OR P2000 OR 03 M 1683 15000
OR P2200 OR 03 M 1783 15000 OR P2400 OR 03 M 1883 15000 OR P2600 OR 03
M 1983 15000 OR P2800 OR 03 M 2083 15000 OR P3000 OR 03 M1000,80,S30,Q
25,I50,PLord Current I*1003 03,15,S20,Q15,P203 030,-15,S30,Q25,I0,P(A)03 S2
S,Q20,M 550 20000 OR P 000 OR 03 S25,Q20,M 550 40000 OR P 100 OR 03
S25,Q20,M 550 60000 OR P 200 OR 03 S25,Q20,M 550 80000 OR P 300 OR 03
S25,Q20,M 550 100000 OR P 400 OR 03 S25,Q20,M 550 120000 OR P 500 OR 03
S25,Q20,M 550 140000 OR P 600 OR 03 S25,Q20,M 450 20000 OR P 000 OR 03
S25,Q20,M 450 40000 OR P 200 OR 03 S25,Q20,M 450 60000 OR P 400 OR 03
S25,Q20,M 450 80000 OR P 600 OR 03 S25,Q20,M 450 100000 OR P 800 OR 03
S25,Q20,M 450 120000 OR P1000 OR 03 S25,Q20,M 450 140000 OR P1200 OR 03
S25,Q20,M 350 20000 OR P 000 OR 03 S25,Q20,M 350 40000 OR P 400 OR 03
S25,Q20,M 350 60000 OR P 800 OR 03 S25,Q20,M 350 80000 OR P1200 OR 03
S25,Q20,M 350 100000 OR P1600 OR 03 S25,Q20,M 350 120000 OR P2000 OR 03
S25,Q20,M 350 140000 OR P2400 OR 03 M330,550,S30,Q25,R900,150,PTorqle (kg
.m) Terminal Voltage03 IO,P TV (v)03 M460,550,I50,PPower03 IO,P (kw)03 M5
60,550,I50,PRevolution N*1003 0-15,3,S20,Q17,P303 020,30,S30,Q25,I0,P(rpm
)03 R0,L4,Y0,600,200,700,230,800,320,900,425,1000,540,1200,765,1300,875,1800
,1438,1830,147003 L3,Y0,660,1060,700,812,800,650,900,560,1000,490,1100,430,1
300,330,1830,20003 L6,Y0,660,200,800,750,900,1030,1000,1190,1130,1260,1300,1
135,1600,675,1830,20003 L0,Y0,600,1400,900,1225,1300,995,1600,823,1850,68003
M1200,1280,PP03 M700,900,PN03 M1600,1300,PT03 M1800,750,PTV (N200*2 +2003 K°
03 PC)03 M900,1400,S40,Q40,PP=1.026*rpm*1003 0-5,30,S20,Q15,P-303 S40,Q40,03
0,-30,P(kw)03 M700,1750,R,S40,Q35,PN0.2 03 00,10,S30,Q25,P1kw03 S40,00,-10,
P/03 S30,0-2,0,P24v03 S40,Q35,P 8-2300-0170 type 03 M1200,1650,Q40,Kリタリツヨシ
9-903 P Power Factor03 M650,1720,E1070,003 00,10,E-1070,003 M1150,1620,E1050
,003 00,10,E-1050,003

```



SS

Fig. 3-9 Interface test 2

3.3 Initialization

The plotter can be initialized in the following way.

- (a) Switch on the power to the plotter
- (b) Press the +Y or -Y switch together with the ENTER switch. Release the +Y or -Y switch first. (Release the ENTER switch first when initializing the plotter when in interface test mode.)
- (c) Output a CLEAR command from the CPU (refer to 5.4.33)
- (d) When the interface is a GP-1B, output a Device Clear (DCL) or Selected Device Clear (SDC) message from the controller.

When the plotter is initialized, the pen moves to the mechanical origin in the lower left corner with respect to the operation panel and then stops at the HOME position. The details of the initial setting at the initialization time command are given in Table 6-1.

3.4 Rear Panel

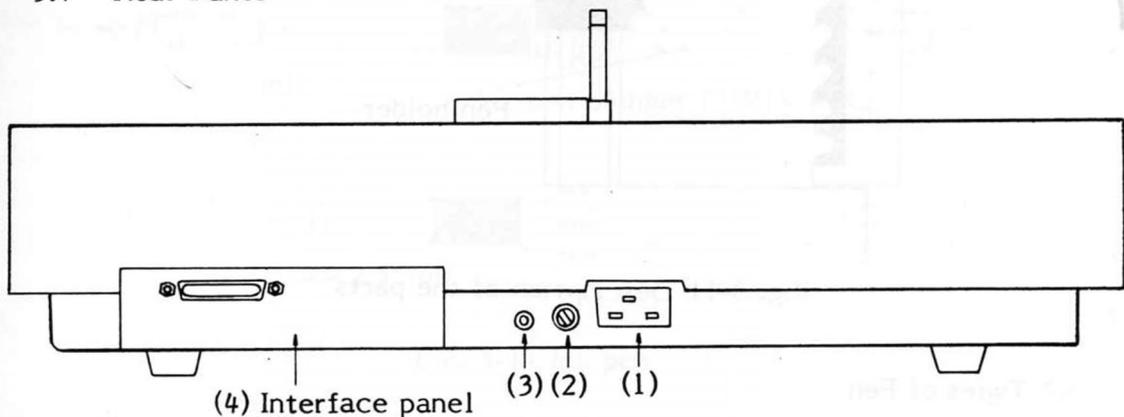


Fig. 3-10 Rear panel

- (1) AC connector
AC power is supplied by connecting the power cable that comes with the machine.
- (2) Glass case fuse holder
When the power supply is 100, 110 or 117 V AC use a 2A slow blow fuse.
When the power supply is 200, 220 or 240 V AC use a 1A slow blow fuse.
- (3) GND: earth terminal (screw: 6 mm diameter)
This is connected to the chassis earth as well as the filter's mid-point, and isolated from the signal earth.

(4) Interface panel

The interface panel is able to extract data from external equipment. This interface card can cooperate only through the GP-IB method as well as the RS-232-C method and the 8 bit parallel method. For the establishment of the interface condition, refer to section 4 Interface.

3.5 Mounting and removal of pens (WX4636(R))

3.5.1 Description of the Parts

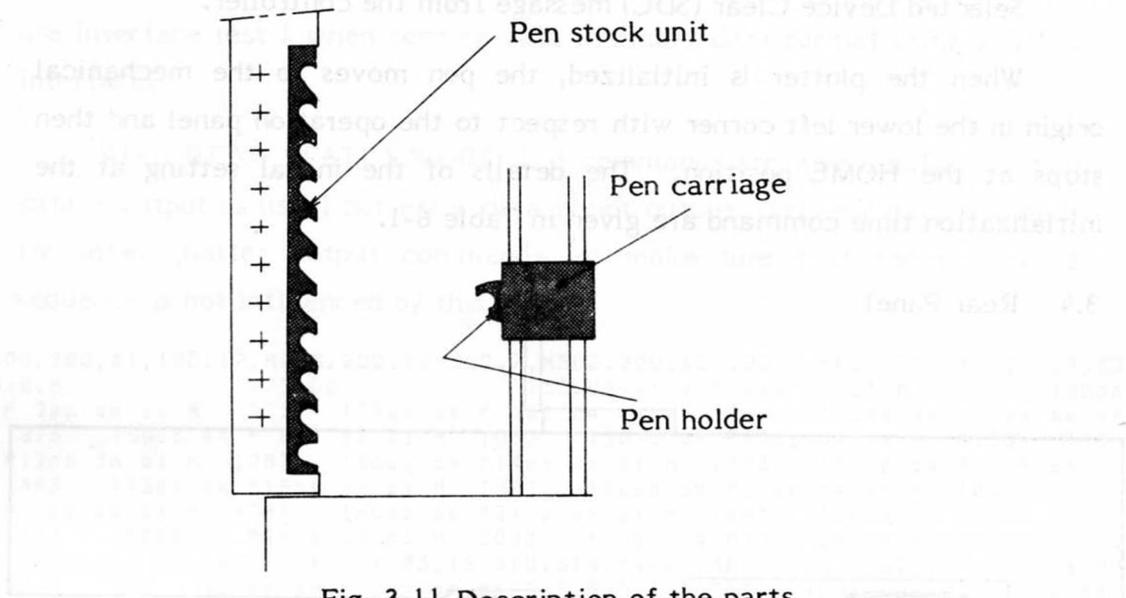


Fig. 3-11 Description of the parts

3.5.2 Types of Pen

- o Fiber-tip pen (water based)

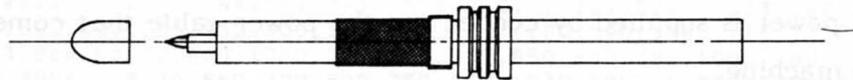


Fig. 3-12 Fiber-tip pen

Put the cap on the pen after use.

- o Ball-point pen (oil based P type)

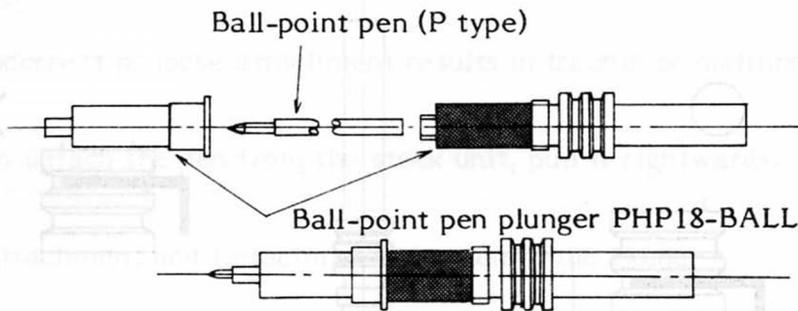


Fig. 3-13 Ball-point pen

The tip of ball-point pen dries up if left unused. Confirm the smooth flow of the ink before use.

- o Ink pen

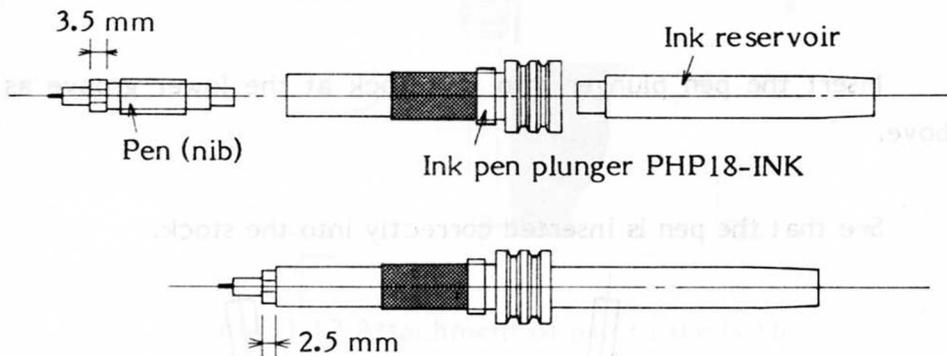


Fig. 3-14 Ink pen

Screw the pen nib into the plunger so that the square portion is inserted 1 mm into the plunger (refer to the above figure). The pen case can be used as a tool to insert the pen nib.

Fill the ink reservoir with ink and insert the reservoir into the plunger. Shake the pen gently up and down until the ink comes out through the nib. Don't shake the pen too strongly as ink may flow from the hole on the side of the nib and cause unsatisfactory drawing.

Disassemble the pen after use, wash it in water and wipe it with a dry cloth.

If the pen is left unused for long with the reservoir full the ink may settle and cause problems such as blockage of the nib or overflow of the ink.

3.5.3 Attachment and Detachment of Pens to the Pen Stock

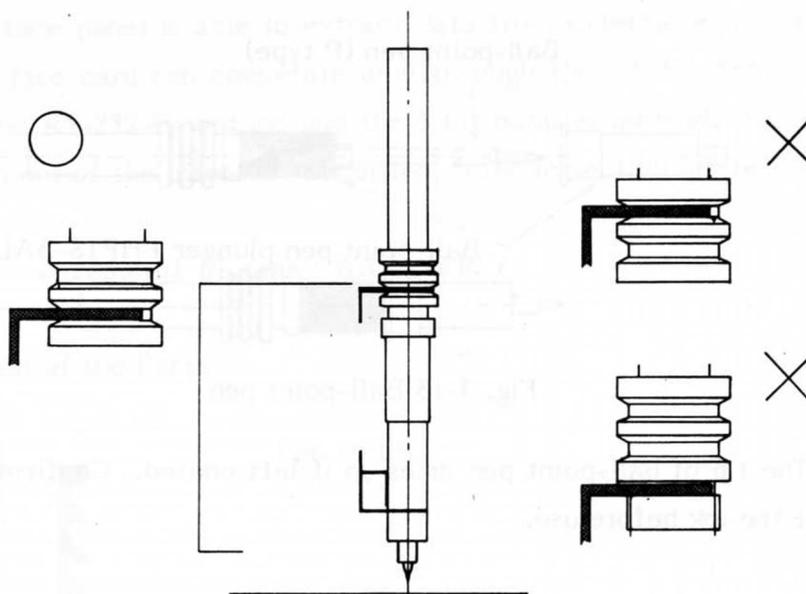


Fig. 3-15 Attachment of pen to pen stock 1

Insert the pen plunger into the stock at the lower groove as shown above.

See that the pen is inserted correctly into the stock.

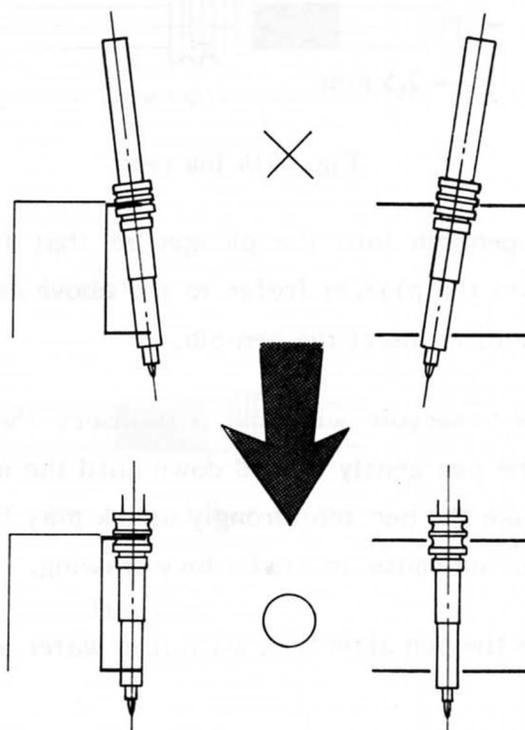


Fig. 3-16 Attachment of pen to pen stock 2

Check that the pen plunger is attached vertically, and that the lower groove is securely held.

Incorrect or loose attachment results in trouble or malfunctions.

To detach the pen from the stock unit, pull it rightwards.

3.5.4 Attachment and Detachment of a Pen in the Holder

The pens are usually first attached in the stocks, but if a pen is to be attached to the holder, refer to the following figure.

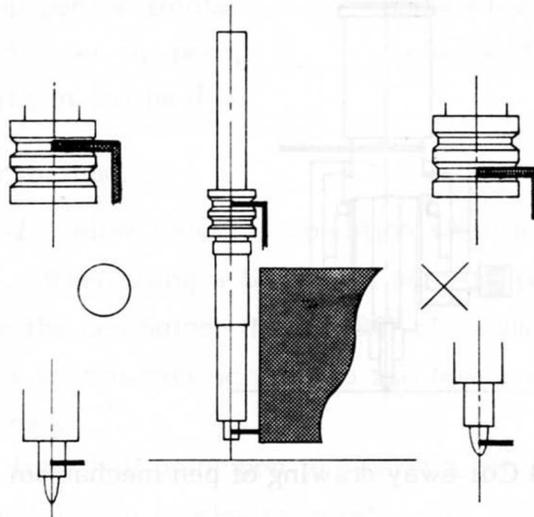


Fig. 3-17 Attachment of pen to the holder

Confirm that the pen is attached correctly in the holder at the groove and the nib.

As with the stock, wrong or loose attachment may result in malfunctions or trouble.

To detach the pen from the holder, pull it leftward.

3-6 Mounting and removal of pens (WX4637(R), WX4638(R))

3-6-1 Pen holder check

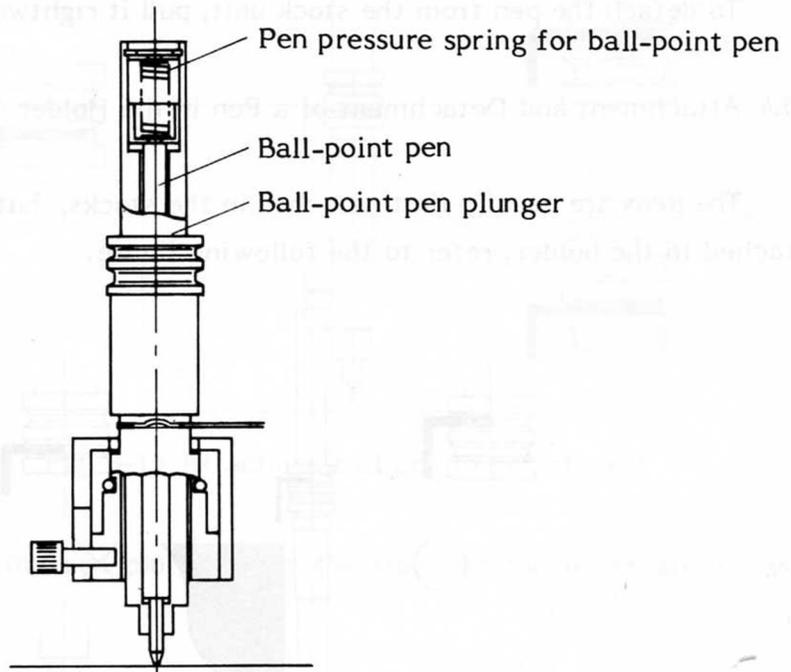


Fig. 3-18 Cut-away drawing of pen mechanism (ball-point pen)

A ball-point pen requires a pen pressure higher than that for a fiber-tip pen, so the relationship between the pen holder and the pen lever differs from that of the fiber-tip pen. When the pen is down, the tip of the ball-point pen touches the writing panel (recording paper) before the lever is attracted and held by the pen coil. As the pen tip touches the writing panel, the ball point pen pressure spring presses the pen down and the lever is attracted and held by the coil against the force of this spring.

Referring to the following drawings, confirm that the pen holder is set correctly according to the pen being used.

The notch of the pen holder is parallel to the arm.

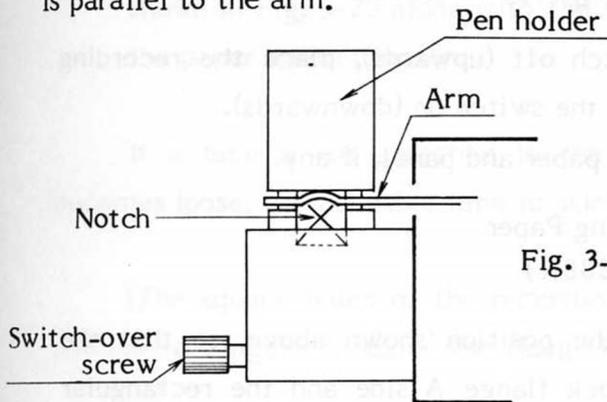


Fig. 3-19

The notch of the pen is at right angles to the arm.

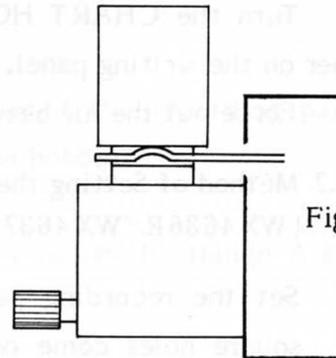


Fig. 3-20

When using a fiber-tip pen or similar (water and oil based fiber-tip pens, water based ball-point pen, ink pen)

Only when a ball-point pen is being used

3-6-2 Pen switch-over method

Fig. 3-21 and 3-22 below show the condition when a fiber-tip pen or similar is being used. When using a ball-point pen, unfasten the switch-over screw and rotate the pen holder through 90° clockwise. A screw hole will appear. Screw the switch-over screw into this hole and the pen holder is set for a ball-point pen.

To switch over from ball-point pen to fiber-tip pen or others, rotate the pen holder through 90° anti-clockwise to return it.

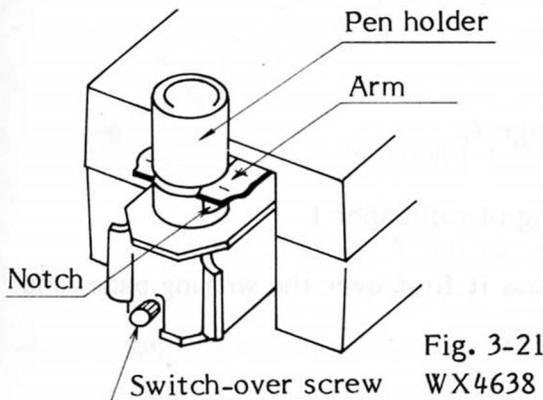


Fig. 3-21
WX4638

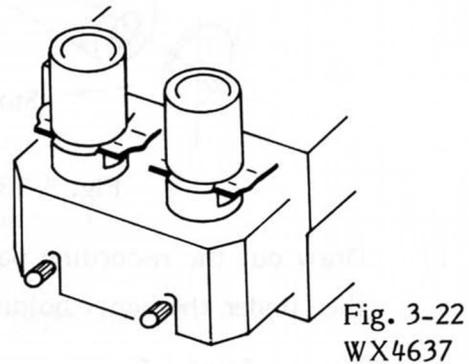


Fig. 3-22
WX4637

Caution

If a fiber-tip or similar pen is used with the pen holder set for a ball-point pen, the pen tip will wear out quickly. Conversely if a ball-point pen is used with the pen holder set for a fiber-tip pen, the required pen pressure will not be obtained and problems such as ink smudging will result.

3.7 Setting and Change-over of Recording Paper

3.7.1 Method of Setting the Recording Paper (WX 4636 /WX 4637 /WX 4638)

Turn the CHART HOLD switch off (upwards), place the recording paper on the writing panel, and turn the switch on (downwards).

Force out the air between the paper and panel, if any.

3.7.2 Method of Setting the Recording Paper (WX 4636R /WX 4637R /WX 4638R)

- a) Set the recording paper in the position shown above, so that the square holes come on the stock flange A side and the rectangular holes on the flange B side.

Push the stock flange B in the direction shown by "←" and insert the core of the paper stock firmly into both flanges.

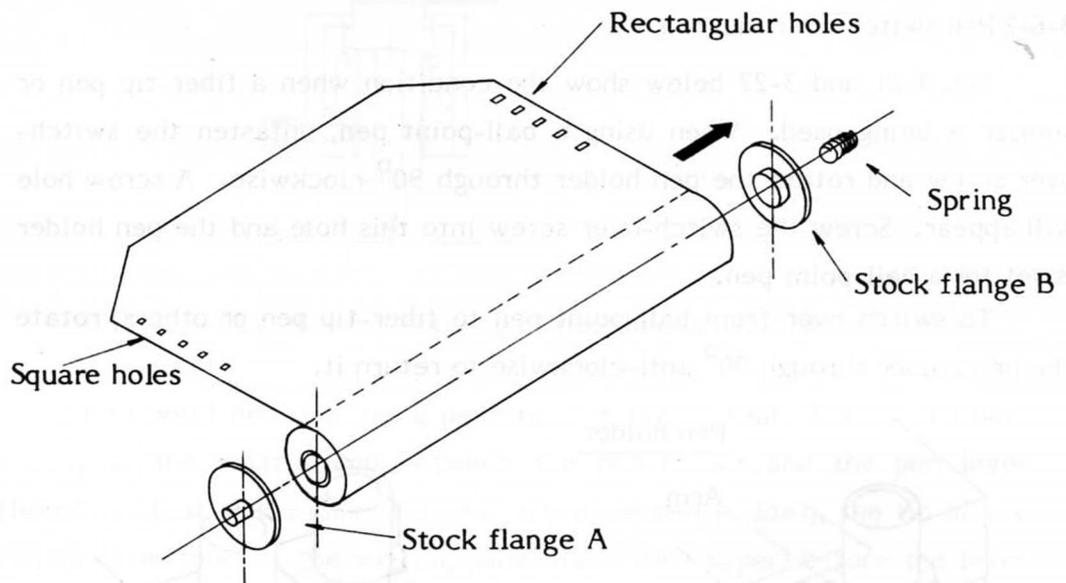


Fig. 3-23 Setting of roll paper 1

- b) Draw out the recording paper, pass it first over the writing panel and then under the paper holding roller.

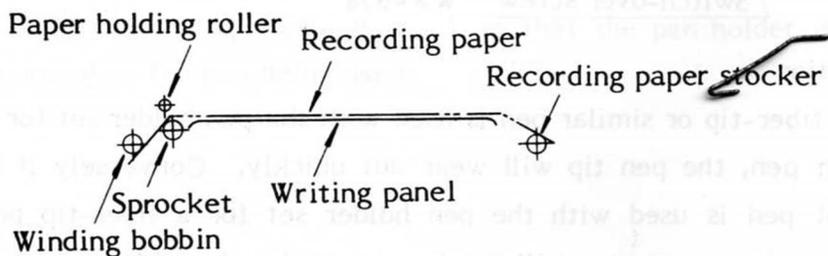


Fig. 3-24 Setting of roll paper 2

- c) Wind the recording paper 2 or 3 times round the winding bobbin as shown in Fig. 3-25 along with the tape attached to the bobbin so that the paper doesn't loosen.

If a tape is not attached to the bobbin, or if the recording paper becomes loose, use adhesive tape to stick it to the bobbin.

(The square holes of the recording paper come on the flange A side and the rectangular holes on the flange B side.)

Push flange B with winding bobbin in the direction of the "←" mark, set the notch in the winding bobbin at the positioning pin of flange A and insert the bobbin firmly into both flanges.

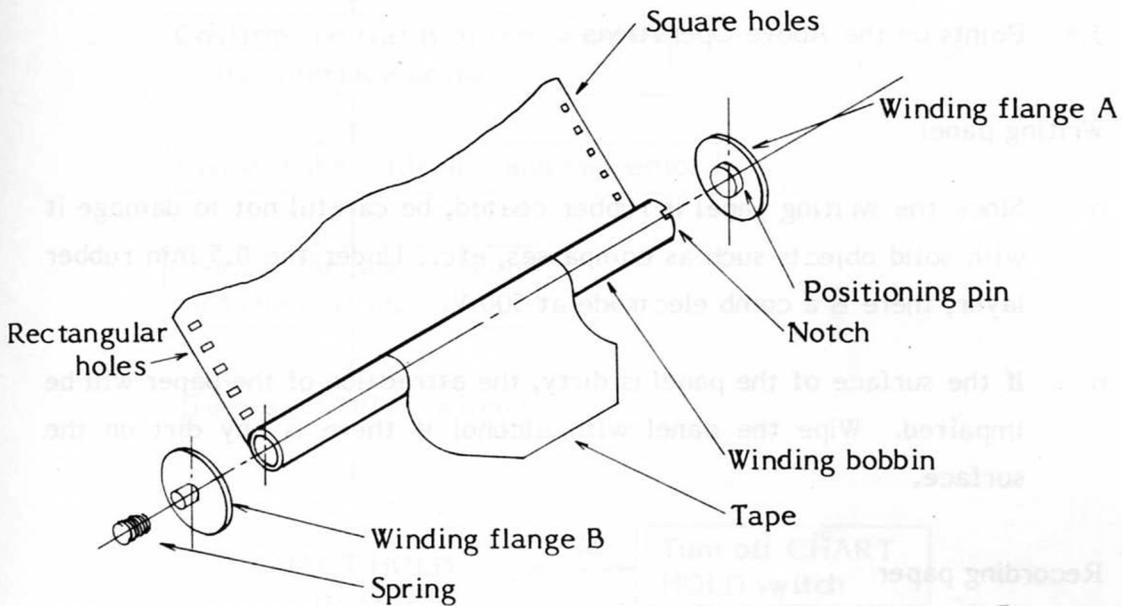


Fig. 3-25 Setting of roll paper 3

- d) Engage the holes of the recording paper with the teeth of the sprockets. Confirm that the holes in the left and right coincide and lower the paper holding roller.

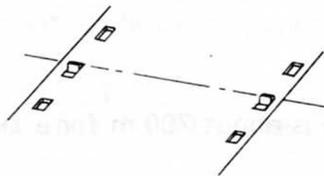


Fig. 3-26 Setting of roll paper 4

- e) Use a recording paper core as the winding bobbin.
 - o If no tape is attached to the core, use adhesive tape to hold the recording paper.
 - o If there is no notch in the core, make a cut for the insertion of the positioning pin as below with a knife.

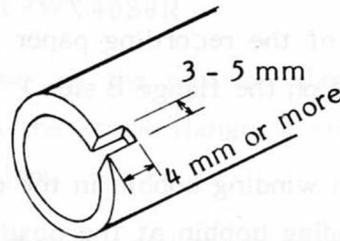


Fig. 3-27 Winding bobbin

3.8 Points on the Above Operations

Writing panel

- o Since the writing panel is rubber coated, be careful not to damage it with solid objects such as compasses, etc. Under the 0.5 mm rubber layer, there is a comb electrode at 500 V.
- o If the surface of the panel is dirty, the attraction of the paper will be impaired. Wipe the panel with alcohol if there is any dirt on the surface.

Recording paper

- o The use of the designated recording paper is recommended.
- o Papers once folded may not be adsorbed. Adsorption of the paper may weaken considerably if the paper is thick, made of plastic (mylar, etc.) or is paraffin based (tracing paper).

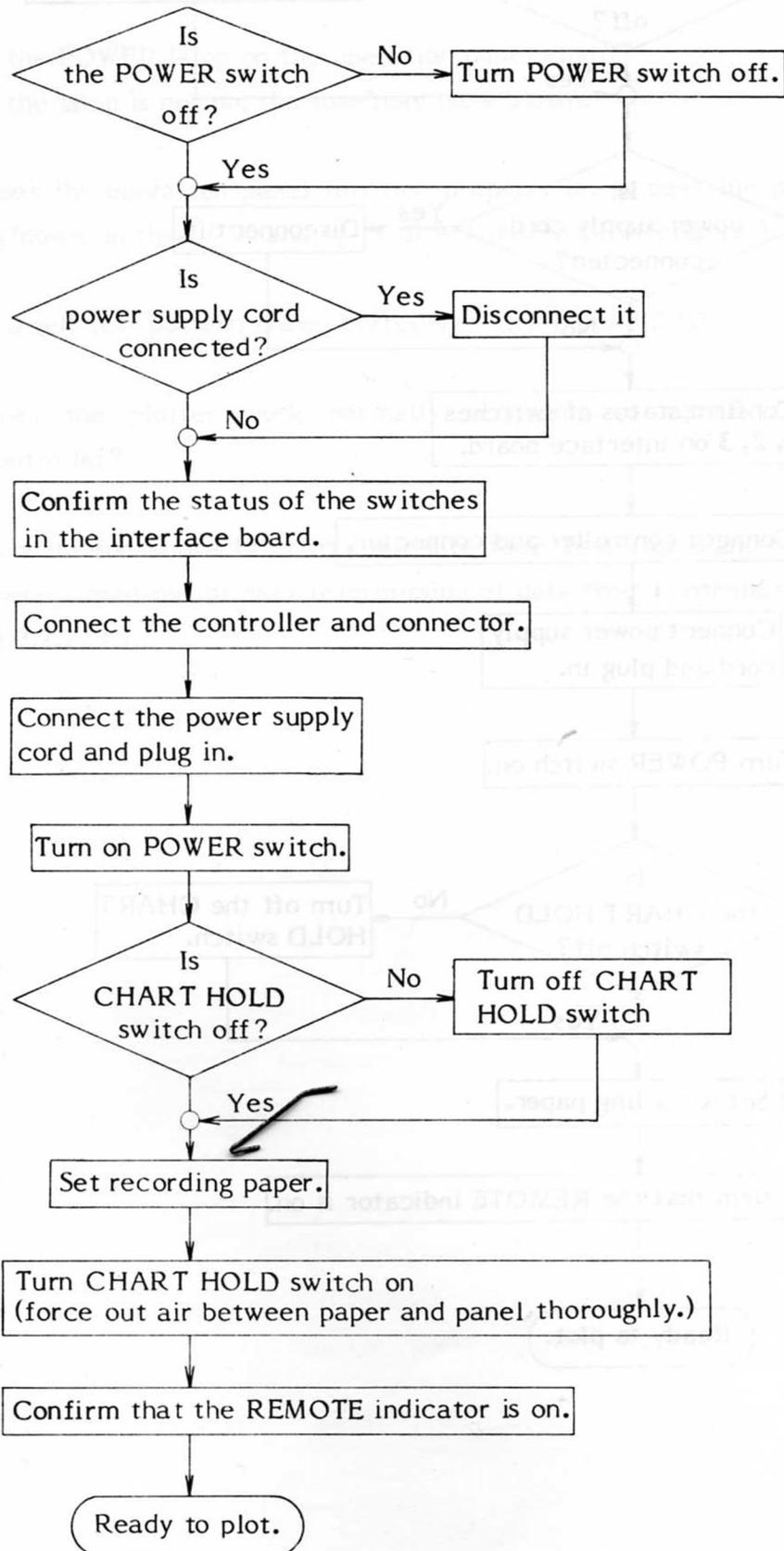
Pens

- o The total drawable length of line is about 700 m for a fiber tipped pen and 550 m for a ball-point pen.
- o If a fiber-tip pen is left down on ordinary recording paper, the ink will blot.

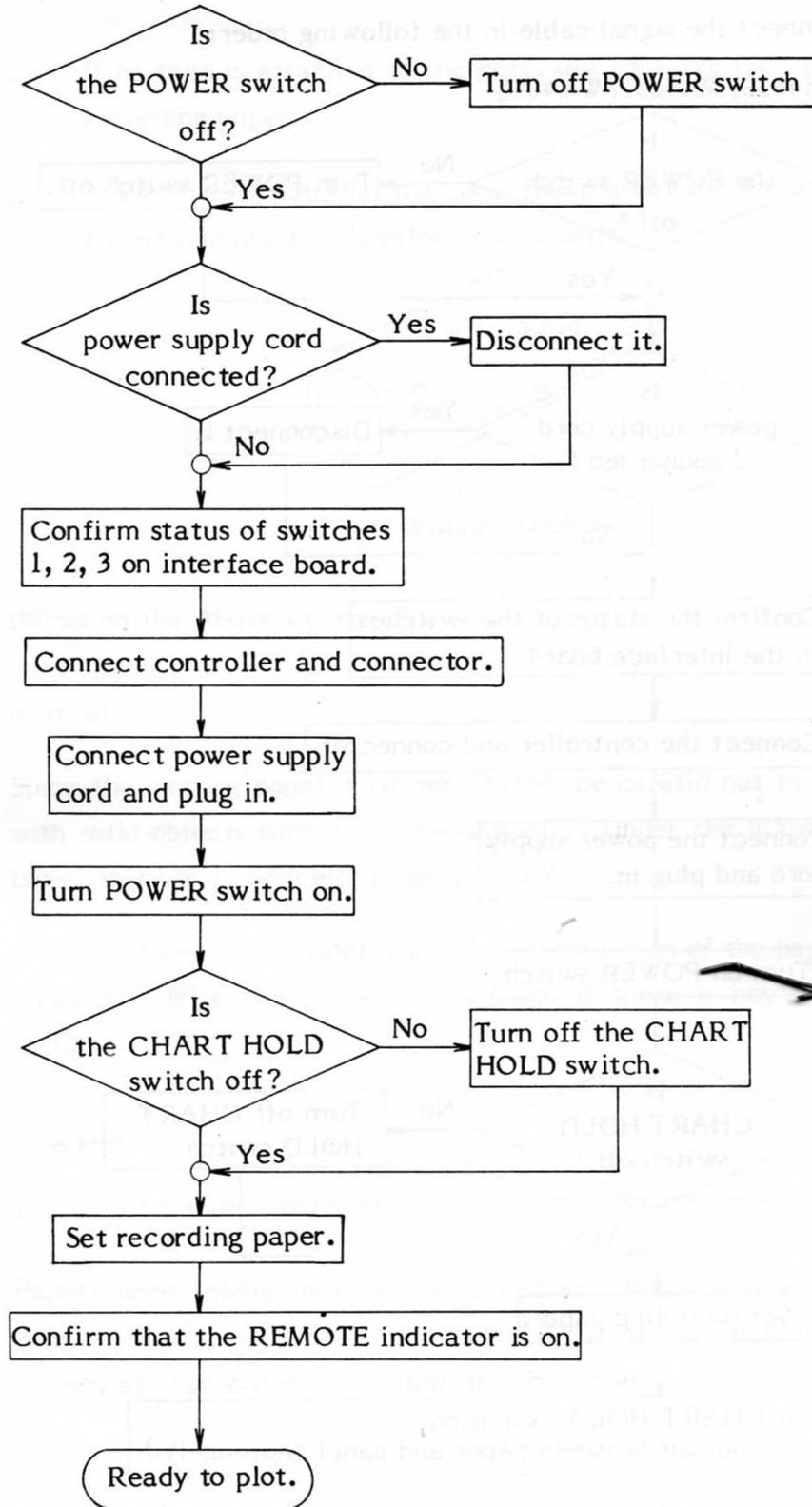
3.9 Order of Operations

Connect the signal cable in the following order:

- (1) WX4636/WX4637/WX4638



(2) WX 4636R / WX 4637R / WX 4638R



3.10 Abnormal Operations

If the plotter operation is abnormal, check the following points.

- (1) Is the POWER lamp on the operation panel alight?
If the lamp is not on, the fuse may have blown.
- (2) Does the operation panel function properly (e. g. does the pen move up/down, in the +/- X and +/- Y directions, etc). (Refer to 3.1.)
- (3) Is a self test pattern drawn correctly? (Refer to 3.2.1.)
- (4) Does the plotter work normally according to signals from the controller?
- (5) If no to the above (4), carry out Interface Test 1 or 2 and check the correct read-out of data transmission of data from controller. (Refer to 3.2.2, 3.)

4. FUNCTION AND TYPE OF INTERFACE

4.1 GP-IB (Unit Number: PC2611)

This is a byte-serial, bit-parallel transmission method; in other words the data is sent 1 byte at a time. The greatest distinctive feature is that data on the buslines between the instruments is controlled by three data transmission control lines using a synchronous plotter code, termed a "3-wire handshake" (IEEE-488 standard).

o GP-IB organization

Bus signal line		Remarks
Data bus	DIO 1 (Data input output 1)	Transmits data and interface commands.
	2 (" 2)	<i>Передача данных и управление</i> <i>по каналу.</i>
	3 (" 3)	
	4 (" 4)	
	5 (" 5)	
	6 (" 6)	
	7 (" 7)	
	8 (" 8)	
Transmission bus	DAV (Data Valid)	Indicates whether data is valid.
	NRFD (Not Ready For Data)	Indicates readiness for data.
	NDAC (Not Data Accepted)	Indicates whether data accepted.
		} Carries out acceptor and source handshakes.
Control bus	ATN(attention)	Indicates that data on the data bus is either an address or command.
	IFC(Interface Clear)	Initializes the interface
	SRQ(Service Request)	Requests for service
	REN(Remote Enable)	Specifies remote or local
	EOI(End or Identify)	Indicates last byte of data, or indicates the parallel polling operation.

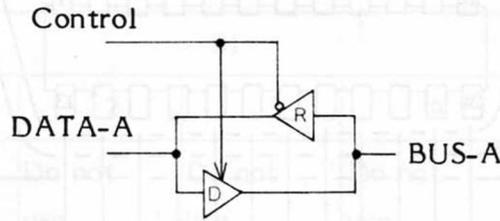
o Electrical characteristics

The levels are standard TTL levels, and the logic states are:

Logic 0: +2.4V at least

Logic 1: +0.8V or less

Input and output circuits are as shown in the following diagram.



75160/161 or equivalent

Fig. 4-1 GP-IB input-output circuit

- o Connectors: Plotter end, 57-20240 (DDK)
Cable end, 57-10240 (")

o Connector pin arrangement

Pin number	Signal line name	Pin number	Signal line name
1	DIO 1	13	DIO 5
2	DIO 2	14	DIO 6
3	DIO 3	15	DIO 7
4	DIO 4	16	DIO 8
5	EOI	17	REN
6	DAV	18	ground
7	NRFD	19	ground
8	NDAC	20	ground
9	IFC	21	ground
10	SRQ	22	ground
11	ATN	23	ground
12	SHIELD	24	logic ground

(The pins linked together in the diagram by dotted lines should be joined by a braided cable.)

The diagram below shows the connectors on the interface unit as seen from the rear.

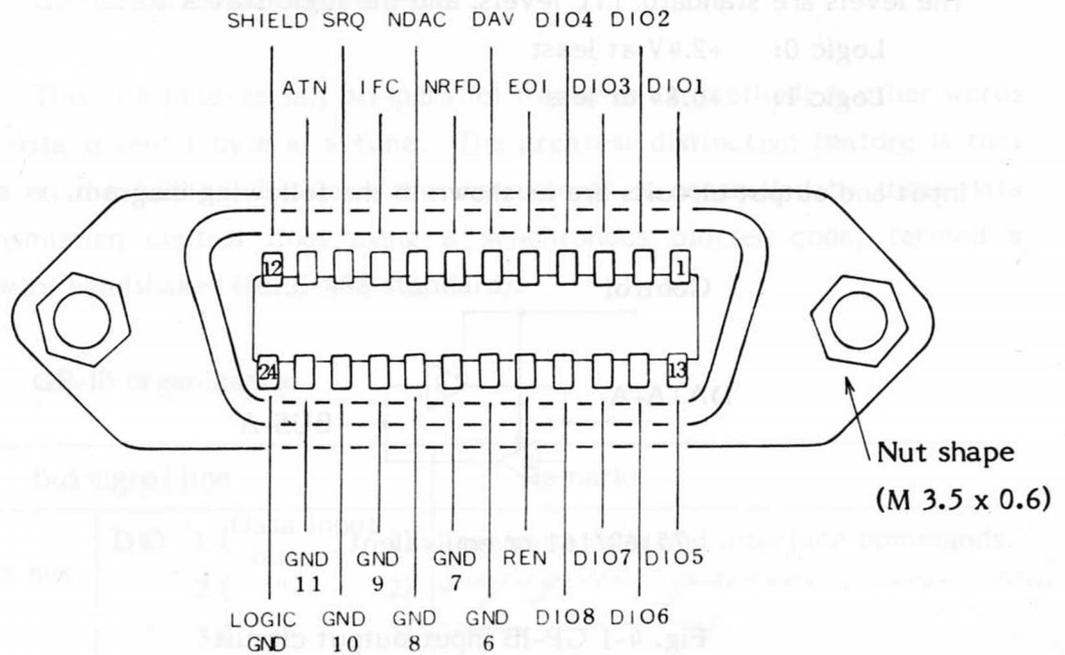


Fig. 4-2 GP-IB connector

o Interface functions

The interface functions are shown below.

GP-IB interface functions

AH-1	Input signal handshake function present
SH-1	Transmission handshake function present
T-6	Basic talker function present; talker only not present.
L-3	Basic listener, listener only mode, and listener exclusion MTA (My Talk Address) functions present.
SR-1	Service request function provided
RL-1	All RL functions present
PP-1	Parallel polling function present
DC-1	All device clear functions provided.
DT-0	Device trigger function absent
C-0	Controller function absent.

- o Data formats:
 - ASCII format (numerical data is represented in decimals as ASCII characters)
 - Binary format (numerical data is handled as 2-byte binary numbers)
- o Buffer memory
 - 1.6 Kbytes
- o Specifications of S1

S1						
Bit No.	1	2	3	4	5	
Operation	Normal:0	Do not use	Do not use	Do not use	Do not use	
	Self test:1	Usually:0	Usually:0	Usually:0	Usually:0	
	6	7	8			
	EOI effective;0 EOI ignored:1	Do not use Usually:0	Do not use Usually:1			

* OPEN side is defined as 1 (throughout this manual).

S1-1

This test confirms correct transference of data from the interface card to the plotter. If the data are correctly transferred, the following is plotted.

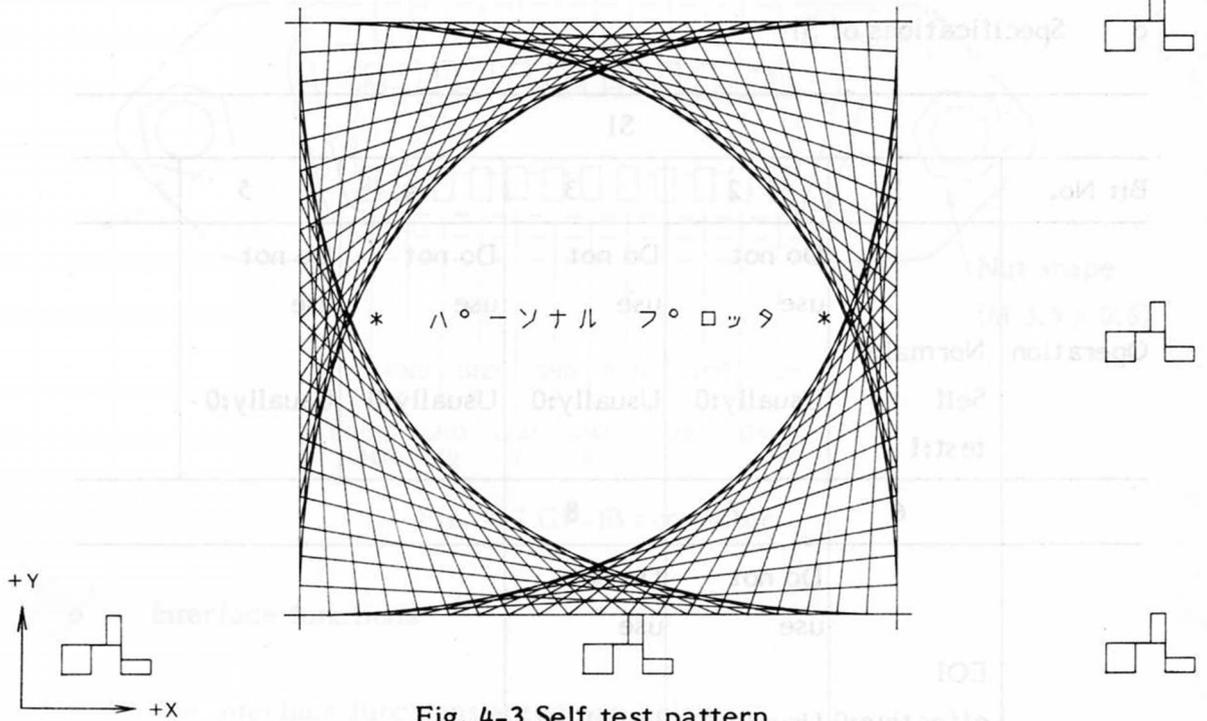


Fig. 4-3 Self test pattern

S1-6

If EOI is received when this switch is at 0, a terminator is automatically inserted and the command finished. When the switch is at 1, EOI is ignored.

S1-2 - 5, 7, 8

Set the switches 2 - 5 to "0" and 8 to "1".

o Specifications of S2

Specifies the mechanical address of plotter.

S2						
No.	(MSB) 1,2	3,4	5,6	7,8	(LSB) 9,10	
Operation	2^4	2^3	2^2	2^1	2^0	

MLA / MTA			S 2				
Address code	MLA character	MTA character	1, 2	3, 4	5, 6	7, 8	9, 10
0	SP	@	0	0	0	0	0
1	/	A	0	0	0	0	1
2	"	B	0	0	0	1	0
3	#	C	0	0	0	1	1
4	\$	D	0	0	1	0	0
5	%	E	0	0	1	0	1
6	&	F	0	0	1	1	0
7	'	G	0	0	1	1	1
8	(	H	0	1	0	0	0
9	)	I	0	1	0	0	1
10	*	J	0	1	0	1	0
11	+	K	0	1	0	1	1
12	,	L	0	1	1	0	0
13	-	M	0	1	1	0	1
14	•	N	0	1	1	1	0
15	/	O	0	1	1	1	1
16	0	P	1	0	0	0	0
17	1	Q	1	0	0	0	1
18	2	R	1	0	0	1	0
19	3	S	1	0	0	1	1
20	4	T	1	0	1	0	0
21	5	U	1	0	1	0	1
22	6	V	1	0	1	1	0
23	7	W	1	0	1	1	1
24	8	X	1	1	0	0	0
25	9	Y	1	1	0	0	1
26	:	Z	1	1	0	1	0
27	;	[	1	1	0	1	1
28	<	\	1	1	1	0	0
29	=	]	1	1	1	0	1
30	>	↑	1	1	1	1	0

Table 4-1 Specifications of MLA/MTA

Note: The address is specified only once when the power is turned on. To respecify the address, turn the power on again or respecify it manually.

o Specifications of S3

LISTEN ONLY is specified by "1". S2 address is effected by "0".

S3	
Operation	Normal:0
	LISTEN ONLY:1

GP-IB (unit number: PC2611) external view

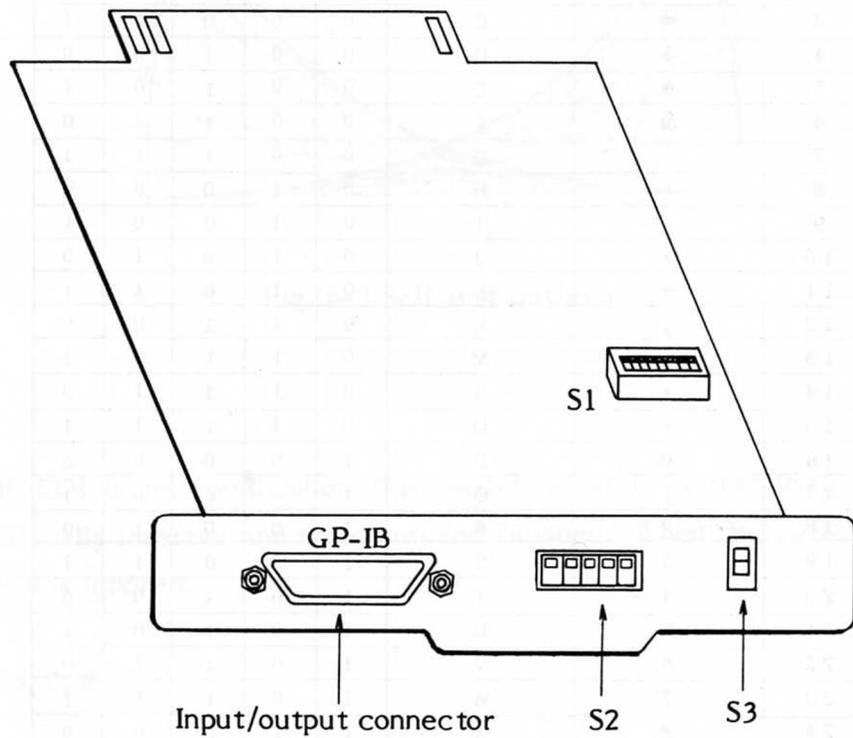


Fig. 4-4 GP-IB unit external view

4.2 RS-232-C Interface (Unit Number: PC2601)

o General specifications (CCITT V24, EIA RS-232-C, JIS C 6361)

Transmission method: Start-stop synchronization, semiduplex and duplex.

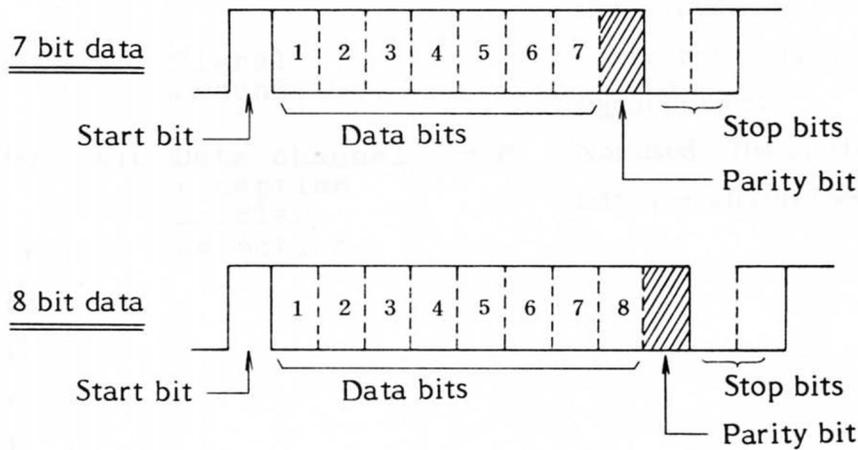
Transmission speeds: 75, 110, 150, 300, 600, 1200, 2400, 4800, and 9600 baud

(switch selectable)

Stop bit: 1, 1½, and 2 bit methods (switch selectable)

Parity: odd, even, or none (switch selectable)

Data length: 7 bits or 8 bits (switch selectable)



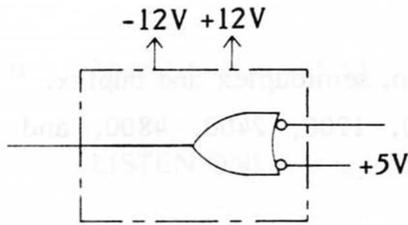
o Electrical characteristics

	RD, SD	RS, CS, DR, ER
	(negative logic)	(positive logic)

Input voltage levels	+5V to +12V	logic "0"	"ON"
	-5V to -12V	logic "1"	"OFF"
Output voltage levels	+5V to +8V typ	logic "0"	"ON"
	-5V to -8V typ	logic "1"	"OFF"
Load impedance	3 to 7 kΩ		

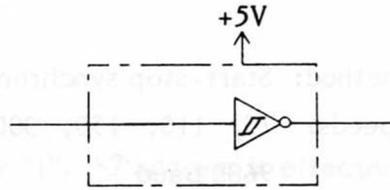
Input/output circuits

Driver circuit



75188 or equivalent

Receiver circuit



75189 or equivalent

- o Connectors used Plotter end DB-25S (Japan Aviation Electronics Industries Ltd.)
Cable end DB-25P

Connector pin arrangement

Terminal number	Signal symbol	Signal name	Signal direction	Function
1	FG	Frame ground	-	Grounds the plotter body
2	SD	Transmitted data	← P	Data is output by the plotter
3	RD	Received data	→ P	Data input to the plotter
4	RS	Request to send	← P	ON when the plotter is sending.
5	CS	Possible to transmit	→ P	The plotter transmits data when the signal is ON.
6	DR	Data set ready	→ P	P Data is valid when this signal is ON.
7	SG	Signal ground	-	Connected to the plotter signal ground.
(8)	CD	Data channel reception carrier detection	→ P	Not used. The plotter is left open circuit (See note 1)
9				
10				
11				
12				
13				
14	*			} (See note 3)
15	*			
16	*			
17	*			
18				
19				
20	ER	Data terminal ready	← P	The signal is ON when the plotter is ready to receive data (See note 2)
21				
(22)	CI	Indication that a call has been	→ P	Not used. Left open circuit at the plotter. (See note 1)
23				
24				
25				

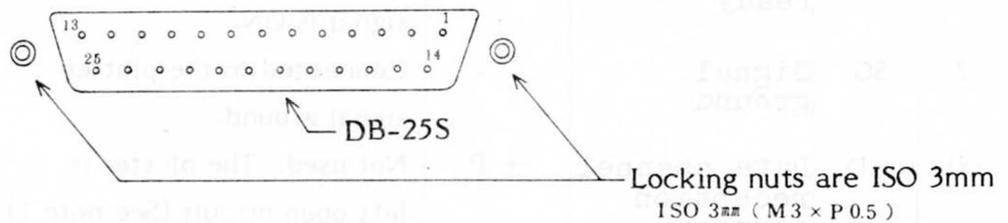
Note 1 Terminal numbers enclosed in parenthesis indicate signals which are ignored by the plotter.

Note 2 The plotter is defined as being ready to receive data when some buffer memory remains free.

Note 3 Where an * appears in the signal code, the corresponding pins should not be connected to signal lines.

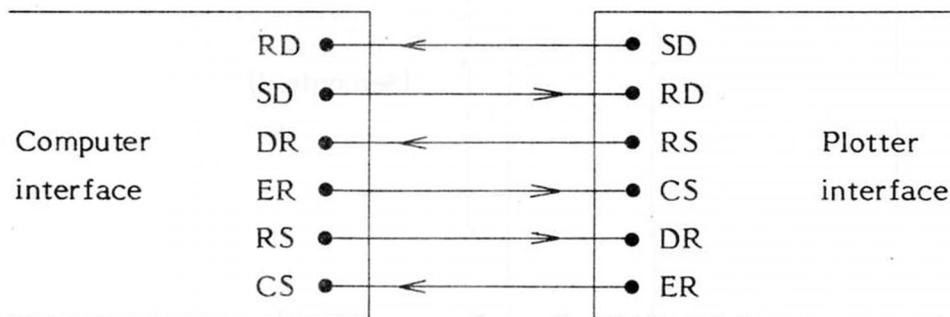
Note 4 The DR signal is normally disregarded. However, depending on the options, it can become effective.

The diagram below shows the connectors on the interface card seen from the rear.



o Standard connection method

This method is applicable when the computer is ready to read in control signals from the plotter.



Example of transmission from the computer to the plotter

Computer	(RS: on)	(CS: on)	Data transmission	(RS: off)
Plotter	(DR: on)	(ER: on)		(DR: off)

Note: Since the ER signal at the buffer end is off only when the buffer is full, when RS is turned on at the computer, CS may already be on. If this buffer full warning is ignored and data is sent regardless, part of the data may be lost.

Example of transmission from the plotter to the computer

Computer	(DR: on)	(ER: on)		(DR: off)
Plotter	(RS: on)	(CS: on)	Data transmission	(RS: off)

Note: When the RS signal at the plotter end is on, even if CS is already on, this is not an error. If during transmission the CS signal goes off, transmission is suspended.

- o Other connection methods
Note that there are other connection methods according to the function of the RS-232-C interface of the computer.
- o Data formats:
ASCII format (numerical data is represented in decimals as ASCII characters)
Binary format (numerical data is handled as 2-byte binary numbers)
- o Buffer memory:
1.6 Kbytes
- o Specifications of S1

S1						
Bit No.	1	2	3	4	5	
		Do not use	Do not use	Do not use	Do not use	
Operation	Normal:0 Self test:1	Usually:0	Usually:0	Usually:0	Usually:0 RS usually ON: 1	

S1			
Bit No.	6	7	8
Operation	Sequence NORMAL :0 CS WAIT:1 Data ignored at DR OFF	Timing of ER ON/ OFF Hysteresis Held:0 Not held: 1	Do not use Usually:1

* OPEN side is defined as 1 (throughout this manual).

S1-1

This test confirms correct transference of data from interface card to plotter. If the data are correctly transferred, the following is plotted.

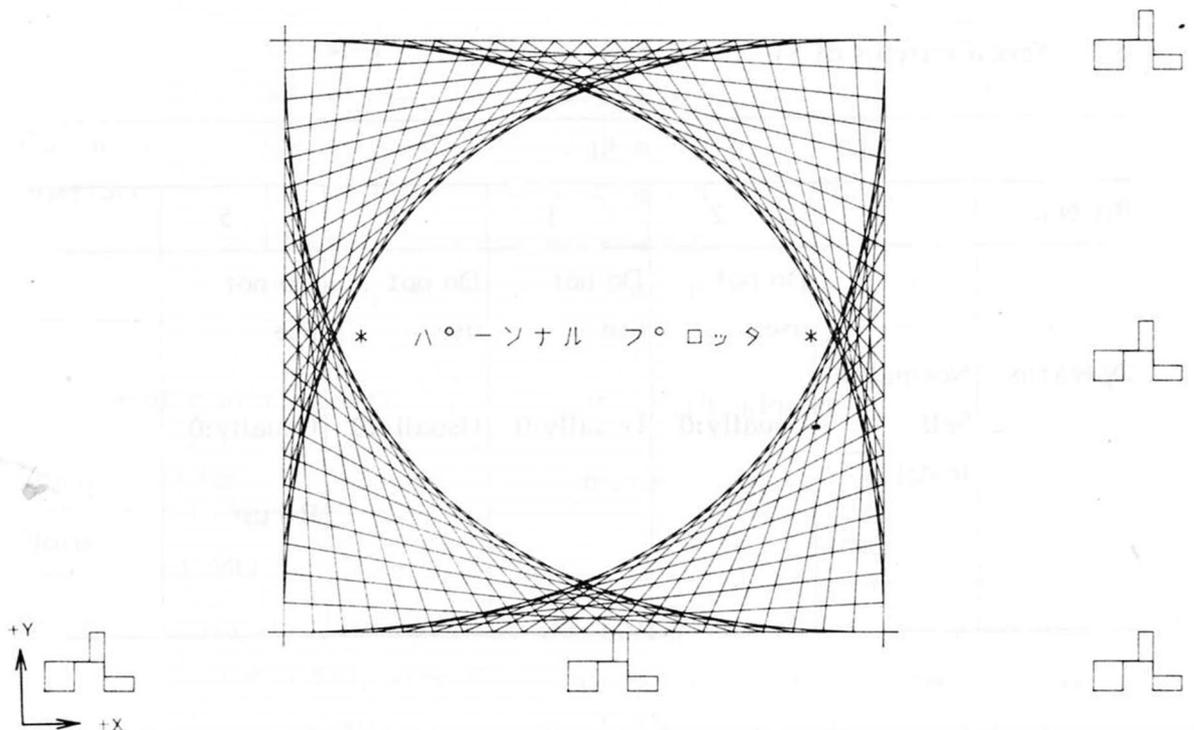
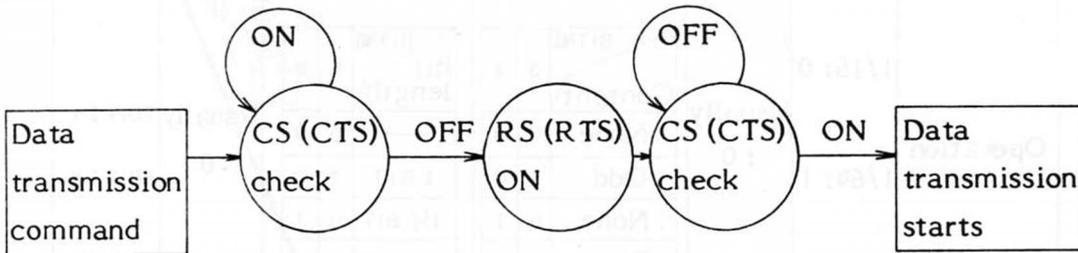


Fig. 4-5 Self test pattern

S1-6

If this switch turned to "1", data inputted when DR OFF are ignored. If CS is already on when data are to be outputted, data output will be held until CS is turned off once and then switched on again.

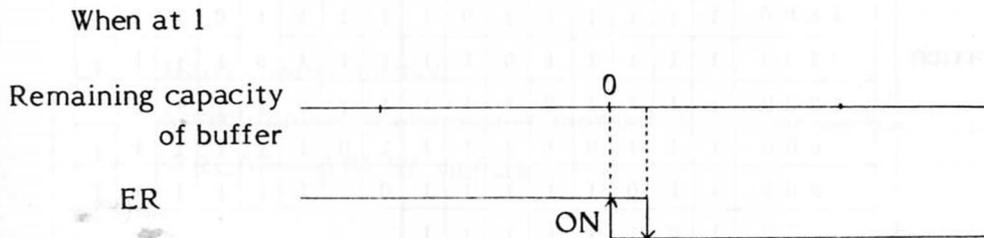
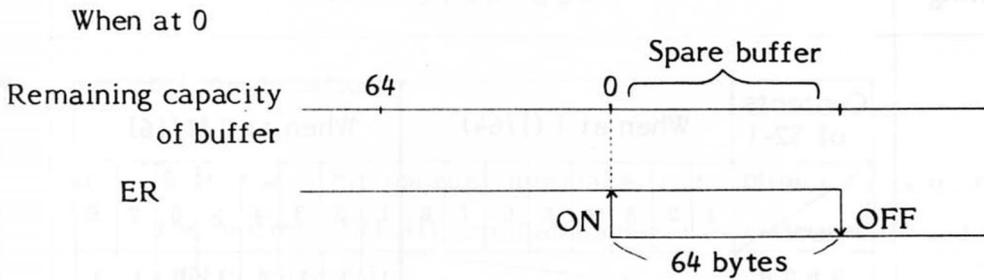


Sequence of start of data transmission

When at 0, all input data are accepted and transmission starts immediately if CS is on.

S1-7

ER (DTR) ON/OFF timing is as follows:



Note: Buffer capacity when empty is 1664 bytes.

S1 - 2 - 5, 8

2 - 5 are set to 0 and 8 is set to 1 as in the S1 Table.

o Specifications of S2

S 2																																												
BIT No.	1	2	3	4	5	6	7	8																																				
Meaning	BAUD RATE FACTOR	Not used	PARITY		STOP BIT		Not used	CHARACTER LENGTH																																				
Operation	1/16: 0 1/64: 1	Usually : 0	<table border="1"> <thead> <tr> <th>BIT No.</th> <th>3</th> <th>4</th> </tr> </thead> <tbody> <tr> <td>Content</td> <td></td> <td></td> </tr> <tr> <td>None</td> <td>0</td> <td>0</td> </tr> <tr> <td>Odd</td> <td>1</td> <td>0</td> </tr> <tr> <td>None</td> <td>0</td> <td>1</td> </tr> <tr> <td>Even</td> <td>1</td> <td>1</td> </tr> </tbody> </table>		BIT No.	3	4	Content			None	0	0	Odd	1	0	None	0	1	Even	1	1	<table border="1"> <thead> <tr> <th>BIT No.</th> <th>5</th> <th>6</th> </tr> </thead> <tbody> <tr> <td>Bit length</td> <td></td> <td></td> </tr> <tr> <td>—</td> <td>0</td> <td>0</td> </tr> <tr> <td>1 BIT</td> <td>1</td> <td>0</td> </tr> <tr> <td>1½ BIT</td> <td>0</td> <td>1</td> </tr> <tr> <td>2 BIT</td> <td>1</td> <td>1</td> </tr> </tbody> </table>		BIT No.	5	6	Bit length			—	0	0	1 BIT	1	0	1½ BIT	0	1	2 BIT	1	1	Usually : 0	7BIT : 1 8BIT : 0
BIT No.	3	4																																										
Content																																												
None	0	0																																										
Odd	1	0																																										
None	0	1																																										
Even	1	1																																										
BIT No.	5	6																																										
Bit length																																												
—	0	0																																										
1 BIT	1	0																																										
1½ BIT	0	1																																										
2 BIT	1	1																																										

o Specifications of S3

S 3																		
BIT No.	1	2	3	4	5	6	7	8										
Meaning	BAUD RATE																	
Operation	Contents of S2-1	When at 1 (1/64)							When at 0 (1/16)									
		BIT No.	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
		BAUD RATE																
		9 6 0 0									1	1	1	1	1	0	1	1
		4 8 0 0	1	1	1	1	1	1	0	1	1	1	1	1	0	1	1	1
		2 4 0 0	1	1	1	1	1	0	1	1	1	1	1	0	1	1	1	1
		1 2 0 0	1	1	1	1	0	1	1	1	1	1	0	1	1	1	1	1
		6 0 0	1	1	1	0	1	1	1	1	1	0	1	1	1	1	1	1
		3 0 0	1	1	0	1	1	1	1	1	0	1	1	1	1	1	1	1
		1 5 0	1	0	1	1	1	1	1	1								
	1 1 0	1	0	1	1	1	1	1	0									
	7 5	0	1	1	1	1	1	1	1									

- o RS-232-C (unit number: PC2601) external view

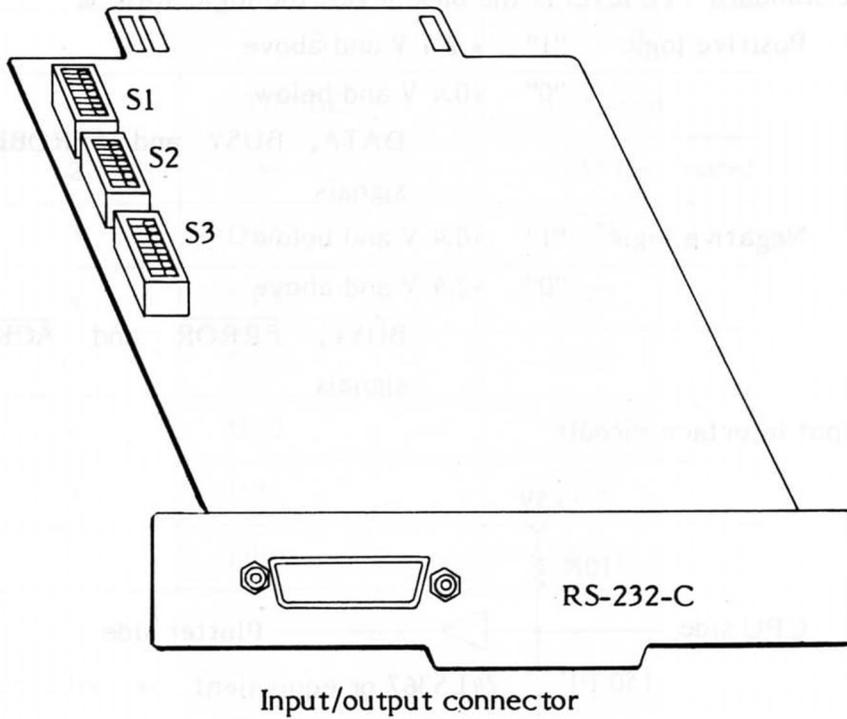


Fig. 4-6 RS-232-C unit external view

4.3 8 Bit Parallel (Unit Number: PC2621)

- o General specifications
 - o With the 8 bit parallel interface, data cannot be output from the plotter. (READ command system as well as GIN and CALL GIN commands)
 - o Transmission method
Asynchronous transmission method depending on hand-shake of STROBE and BUSY signals

o Electrical characteristics

The standard TTL level is the base level, the logic state is

Positive logic "1" + 2.4 V and above
 "0" +0.4 V and below

DATA, BUSY and STROBE signals

Negative logic "1" +0.4 V and below
 "0" +2.4 V and above

$\overline{\text{BUSY}}$, $\overline{\text{ERROR}}$ and $\overline{\text{ACK}}$ signals

o Input/output interface circuit

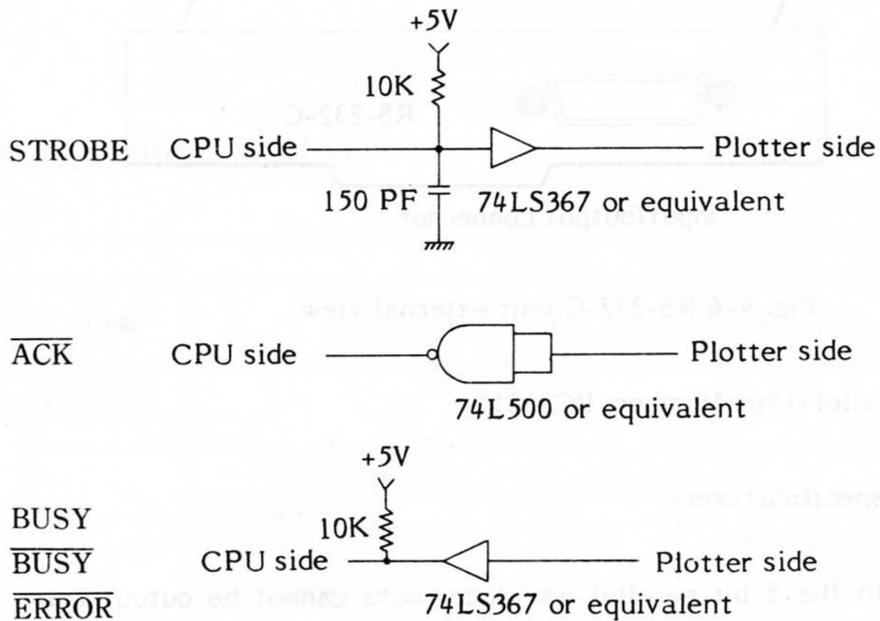


Fig. 4-7 Input/output interface circuit

o Connectors used:

Plotter side ECN-361P016-AG (Fujitsu)
 Cable side ECN-361J016-AG (")

o Connector pin arrangement

	A	B
1	STROBE	not used
2	DB6	DB7 (See note)
3	DB5	$\overline{\text{BUSY}}$
4	DB4	GND
5	DB3	GND
6	DB2	$\overline{\text{ERROR}}$
7	DB1	$\overline{\text{ACK}}$
8	DB0	BUSY

o Data format

o ASCII format: Numerical data is represented in decimals as ASCII characters

o Binary format: Numerical data is handled as 2-byte binary numbers. Usable only when S1 is off. When S1 is on, this format cannot be used.

o Buffer memory

o 100 bytes

o S1 setting

Off when input data used is 7 bits. On when 8 bits used.

o Input/output timing chart

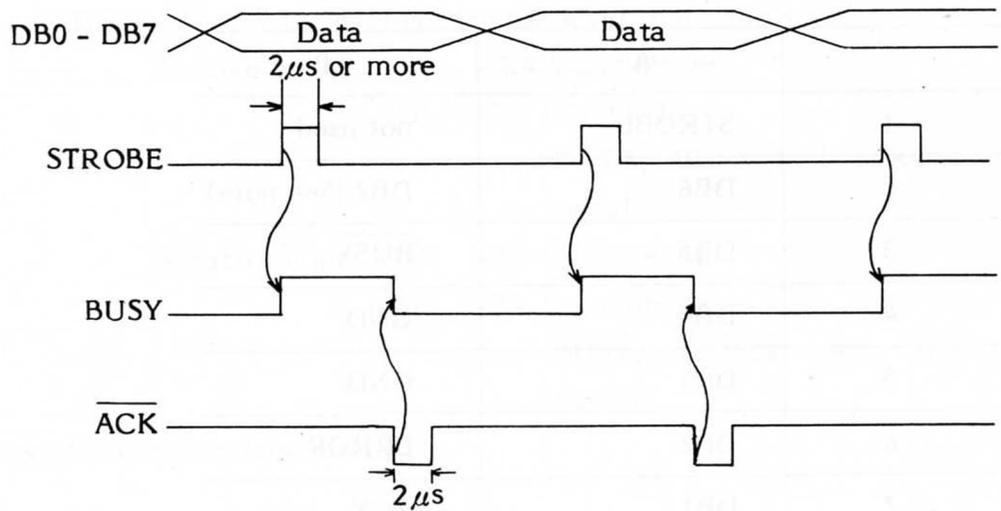


Fig. 4-8 Input/output timing chart

Note: Input data should be maintained from the time STROBE goes high until the time ACK signal goes high.

o 8 bit parallel (unit number: PC2621) external view

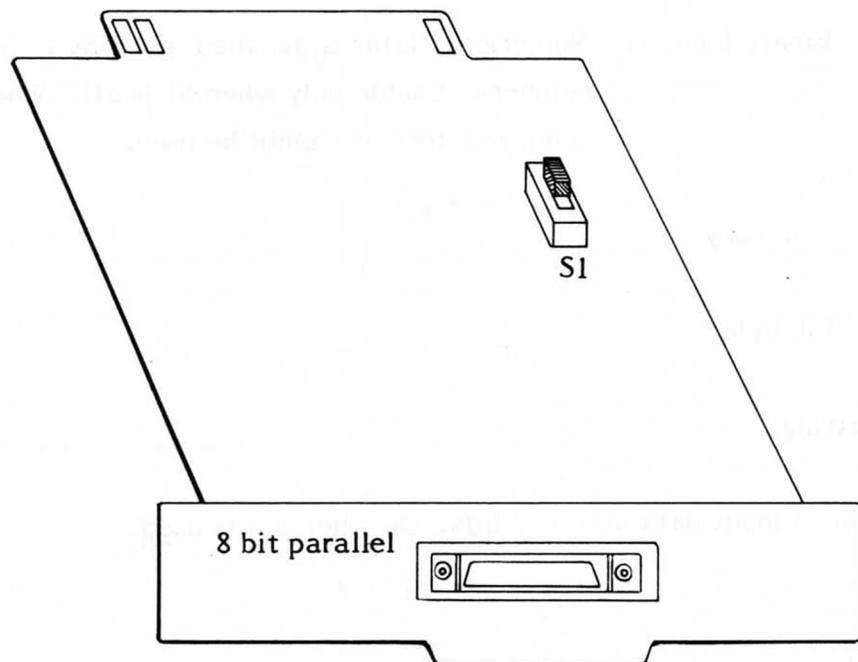


Fig. 4-9 8 bit parallel unit external view

5. COMMAND FUNCTIONS

5.1 Terms

o Machine origin:

The lower left limit the pen can move to on the writing panel. When the plotter is initialized, the pen first moves automatically to this point and then goes to the HOME position.

o HOME position:

The origin that is automatically established when the plotter is initialized.

o OFFSET position:

The origin in the program, this is freely selectable by the OFFSET command and coincides with the HOME position when the plotter is initialized.

o GDU (Graphic Display Unit):

The minimum programmable unit, coordinates are all expressed in integral multiples of this unit. 1 GDU equals 0.1 mm when FACTOR not requested.

o Plotting area:

The area set by specifying LOWER LEFT and UPPER RIGHT. The maximum valid plotting area will be defined as the plotting area when the plotter is initialized.

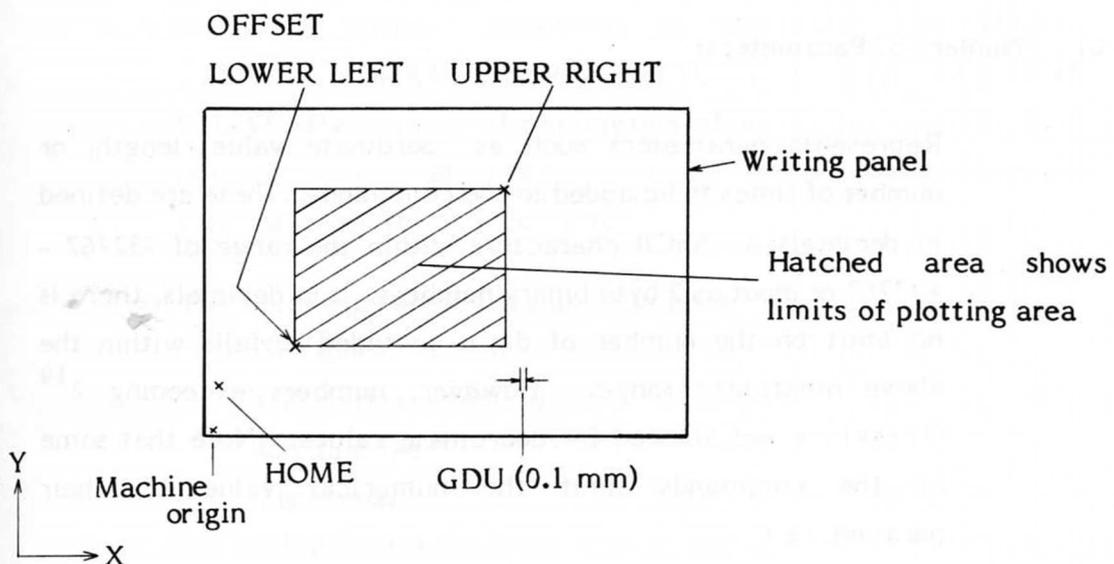


Fig. 5-1 Plotting area

o **DIRECT COMMAND:**

Commands that are performed immediately upon receipt by the plotter and are not stored in the buffer memory.

These are: CLEAR, INTERFACE CLEAR, READ STATUS WORD 1, READ STATUS WORD 3.

o **MLA (My Listen Address):**

This is a bus line message of the GP-IB. Specifies the equipment to be used as listener.

o **MTA (My Talk Address):**

This is a bus line message of the GP-IB. Specifies the equipment to be used as talker.

5.2 Data Elements

The input data to the plotter are composed of the following elements. Some of them are unnecessary depending on the kind of command. Refer to section 5.3 for their combination.

a) **Command Data Byte:**

Indicates the kind of command in ASCII characters. Always needed at the start of the command. Shown in uppercase letters in the chart in section 5.4.

b) **Numerical Parameters:**

Represents parameters such as coordinate value, length, or number of times to be added to the commands. These are defined in decimals as ASCII characters within the range of -32767 - +32767 or input as 2 byte binary numbers. If in decimals, there is no limit on the number of digits provided it falls within the above mentioned range. However, numbers exceeding 2^{14} (16384) are not allowed for coordinate values. (Note that some of the commands limit the numerical value of their parameters.)

"+" and "-" signs are allowed in decimals. If no sign is specified, the number is regarded as a positive number. Decimal points and decimal fractions are ignored though they are not regarded as errors.

Numerical values including an exponent (e. g. 123E-1) are not permitted. These are shown in lowercase letters in the chart in section 5.4.

Correct examples: 345.0, -345, +345

When the parameters are input in binary numbers, they are represented in 2 bytes (in the order of upper byte and lower byte). Negative numbers are represented in complementary notation.

c) Character Parameters:

Character codes to be added to the commands are represented as ASCII characters, in JIS 7 unit code or in JIS 8 unit code. (Refer to the code chart at the end of this manual for details.)

Example: "A" "1" "ア"
(41)₁₆ (31)₁₆ (B1)₁₆ or SO (31)₁₆

d) Delimiters:

These must be put at the end of all numerical parameters to punctuate them. However, in commands like DRAW, RELATIVE DRAW, USER'S PATTERN, CURVE, RELATIVE CURVE, the number of parameters of which are variable, it is not necessary to add a delimiter to the last parameter since the terminator serves as a delimiter.

The following can be used as delimiters:

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

The details on the use of delimiters are given in section 5.3. In section 5.4 Commands, they are represented as a "," (comma).

e) Terminator:

Indicates the end of commands, the parameters (numerical and character) of which are variable (refer to section 5.3). This code can be specified by a TERM command. If not otherwise specified, (ETX) will be the terminator.

This is defined as (T) hereafter (EOI is effective as a terminator in the GP-IB).

5.3 Data Format

5.3.1 Input Data Format

The input data format is common to all types of interface. However, if LISTEN ONLY is not designated with the GP-IB interface, MLA (My Listen Address) of the plotter should be input in advance of data transmission. If this MLA differs from the value specified in the GP-IB interface unit in the plotter, all data input thereafter are void.

But if LISTEN ONLY is designated, all input data are valid despite their differences.

If the MLA of a data input is the same as that of the data input just before it, it can be omitted.

Example) Input data when the MLA of the plotter is (1)

MLA(1)	DATA1	MLA(2)	DATA2	MLA(1)	DATA3	DATA4
↓	↓		↓		↓	↓
Plotter	valid		invalid		valid	valid

There are 2 kinds of input data format, the ASCII format representing data in decimals as ASCII characters and the 2-byte format handling data as 2-byte binary numbers.

1) ASCII data format

a) Format type 1

Commands with a fixed number of numerical parameters.

Command data byte	Numerical parameter	Delimiter	Numerical parameter	Delimiter	Numerical parameter	Delimiter
-------------------	---------------------	-----------	---------------------	-----------	---------------------	-----------

The necessary number of numerical parameters follow the command data, byte, each punctuated by a delimiter. The delimiter at the end of the whole data string can be replaced by the terminator. Commands of this type are as shown in Table 5-1.

COMMAND	COMMAND DATA BYTE	COMMAND FORMAT
LINE TYPE	L	Lp,
LINE SCALE	B	B l ,
ALPHA SCALE	S	S n ,
ALPHA SPACE	Q	Q l ,
ALPHA ROTATE	R	R θ ,
ALPHA ITALIC	I	I p ,
FONT	\$	\$ n ,
MARK	N	N n ,
PROMPT LIGHT	T	T n ,
CHART FEED	F	F l ,
NEW PEN	J	J n ,
MOVE	M	M x, y ,
RELATIVE MOVE	O	O $\Delta x, \Delta y$,
WRITE LOWER LEFT	\	\ x, y ,
WRITE UPPER RIGHT	Z	Z x, y ,
OFFSET	↑	↑ x, y ,
FACTOR	&	& p, q, r ,
ERROR MASK	"	" m, n, p ,
AXIS	X	X p, q, r ,
HATCHING	%	% n, x, y, d, θ ,
RELATIVE CIRCLE	]	]$r_1, r_2, \theta_1, \theta_2$,
CIRCLE	W	W $x_0, y_0, x_1, y_2, \theta_1, \theta_2$,
SPEED	/	/ l ,

Table 5-1 Commands of type 1

Example)

M1000, 2000, S50, N2, (ETX)

(carried out in the order of MOVE, ALPHA SCALE, MARK)

b) Format type 2

Commands with a variable number of numerical parameters.

Command data byte	Numerical parameter	Delimiter	Numerical parameter	Delimiter	Numerical parameter	Terminator
-------------------	---------------------	-----------	---------------------	-----------	---------------------	------------

Numerical parameters punctuated by delimiters follow the command data byte. A terminator comes at the end of the last parameter. Commands of this type are shown in Table 5-2.

COMMAND	COMMAND DATA BYTE	COMMAND FORMAT
RELATIVE DRAW	E	$E\Delta x_1, \Delta y_1, \dots, \Delta x_n, \Delta y_n (T)$
DRAW	D	$Dx_1, y_1, \dots, x_n, y_n (T)$
CURVE	Y	$Y a, x_1, y_1, \dots, x_n, y_n (T)$
RELATIVE CURVE	←	$\leftarrow a, \Delta x_1, \Delta y_1, \dots, \Delta x_n, \Delta y_n (T)$
USER'S PATTERN	(	$(n_1, n_2, \dots, n_k (T)$

Table 5-2 Commands of type 2

Example)

D100, 100, 200, 100, 300, 200(T), E100, 0, 0, 100, -100, 0(T)

(carried out in the order of DRAW (3 points), RELATIVE DRAW (3 points))

c) Format type 3

Commands with character parameters.

Command data byte	String of character parameters	Terminator
-------------------	--------------------------------	------------

A string of character parameters follows the command data byte. A terminator comes at the end of the last character parameter. The commands of this type are shown in Table 5-3.

COMMAND	COMMAND DATA BYTE	COMMAND FORMAT
PRINT	P	P c ₁ c ₂ c _n (T)
KANA	K	K c ₁ c ₂ c _n (T)

Table 5-3 Commands of type 3

Example)

PABCDEFG(T)Kアイウエオ(T)

(carried out in order of PRINT (7 characters), KANA (5 characters))

d) Format type 4

Commands with no parameters (numerical or character). The command is specified by a single character command data byte. The commands of this type are shown in Table 5-4.

Command data byte

COMMAND	COMMAND DATA BYTE
READ STATUS WORD 1	V
READ STATUS WORD 2	@
READ STATUS WORD 3	#
ALPHA RESET	A
HOME	H
GIN	G
CALL GIN	C
READ LOWER LEFT	[
READ UPPER RIGHT	U
CLEAR	:
INTERFACE CLEAR	;

Table 5-4 Commands of type 4

Note: Do not send any characters directly after CLEAR or I/F CLEAR commands. (Wait the designated time before sending characters.)

Example)

HA (carried out in the order of HOME, ALPHA RESET)

e) Format type 5

TERM command

Command data byte	Code	Code
-------------------	------	------

2 codes follow the command data byte.

Example)

= $(0D)_{16}$ $(0A)_{16}$

(this specifies the terminator as $(0D)_{16}$ $(0A)_{16}$)

2) Binary data format

Parameters are handled in 2-byte binary numbers.

2-byte format is easily distinguishable from ASCII format by the binary control code $(80)_{16}$ directly before the command data byte. This binary code must be used in the 2-byte format.

To change the format from 2-byte commands to ASCII, codes $(80)_{16}$ $(00)_{16}$ are inserted just before the ASCII command.

a) Format type 1

Commands with a fixed number of parameters

Binary control code $(80)_{16}$	Command data byte	Numerical parameter	Numerical parameter	---	Numerical parameter
---------------------------------	-------------------	---------------------	---------------------	-----	---------------------

After the binary control code $(80)_{16}$ comes the command data byte and the necessary number of numerical parameters expressed in binary numbers in the order from the highest ranking byte to the lowest ranking byte. Commands of this type are as in Table 5-1.

Example)

$(80)_{16}$ $(4D)_{16}$ $(03)_{16}$ $(E8)_{16}$ $(07)_{16}$ $(D0)_{16}$ $(80)_{16}$ $(53)_{16}$ $(00)_{16}$ $(32)_{16}$

$(80)_{16}$ $(4E)_{16}$ $(00)_{16}$ $(02)_{16}$

(this is the same as M1000, 2000, S50, N2)

b) Format type 2

Commands with a variable number of numerical parameters.

Binary control code (80) ₁₆	Command data byte	Numerical parameter	Numerical parameter	Numerical parameter	Binary control code (80) ₁₆
--	-------------------	---------------------	---------------------	---------------------	--

Numerical parameters follow the command data byte. A binary control code (80)₁₆ is inserted immediately after the last numerical parameter. This binary control code can be replaced by the following control code. The commands of this type are shown in Table 5-2.

Example)

(80)₁₆ (44)₁₆ (00)₁₆ (64)₁₆ (00)₁₆ (64)₁₆ (00)₁₆ (C8)₁₆ (00)₁₆
 (64)₁₆ (01)₁₆ (2C)₁₆ (00)₁₆ (C8)₁₆ (80)₁₆ (45)₁₆ (00)₁₆ (64)₁₆
 (00)₁₆ (00)₁₆ (00)₁₆ (00)₁₆ (00)₁₆ (64)₁₆ (FF)₁₆ (9C)₁₆ (00)₁₆
 (00)₁₆ (80)₁₆

(this is the same as D100, 100, 200, 100, 300, 200 (T) E100, 0, 0, 100, -100, 0(T))

c) Format type 3

Commands with character parameters

Binary control code (80) ₁₆	Command data byte	String of character parameters	(Terminator)	Binary control code (80) ₁₆
--	-------------------	--------------------------------	--------------	--

A string of character parameters follows the command data byte and a terminator or binary control code (80)₁₆ is placed at the end of the last character parameter. This terminator can be replaced by the following control code. This binary control code can also be the binary control code of the following command data byte. The commands of this type are shown in Table 5-3.

Example)

(80)₁₆ (50)₁₆ (41)₁₆ (42)₁₆ (43)₁₆ (80)₁₆ (4B)₁₆ (31)₁₆ (32)₁₆
 (33)₁₆ (80)₁₆

(carried out in the order of PRINT (3 characters), KANA (3 characters))

d) Format type 4

Commands without parameters (numerical or character). Commands are specified by a binary control code and a single character command data byte. The commands of this type are shown in Table 5-4.

Binary control code $(80)_{16}$	Command data byte
---------------------------------	-------------------

Example)

$(80)_{16}$ $(48)_{16}$ $(80)_{16}$ $(41)_{16}$

(carried out in the order of HOME and ALPHA RESET)

Note: Please use $(80)_{16}$ $(00)_{16}$ when returning from binary format to ASCII format.

5.3.2 Output Data Format

Commands to output data from the plotter are GIN, CALL GIN, READ LOWER LEFT, READ UPPER RIGHT, READ OFFSET, READ STATUS WORD 1, 2, 3.

These commands return the data, whose content and format are designated by the type of command, to the controller. The data will be ASCII format or 2 byte binary format depending on the format of the respective commands.

The timing of the data output differs according to the type of interface. With the GP-IB interface, for example, data cannot be output by the READ command only. Data is output after a MTA (My Talk Address) bus line message is input.

Example) Plotter's MLA: (1) Controller's MLA: (2)

Data line	MLA (1)	READ command	MTA (1)	MLA (2)	Data output
-----------	---------	--------------	---------	---------	-------------

Controller is talker.

Controller is listener.

Plotter is listener.

Plotter is talker.



MTA has no effect with the RS-232-C interface. Data can't be output with the 8 bit interface.

1) ASCII format data

Data output from plotter is in ASCII format if the READ command is in ASCII format. Output data is represented in decimals as ASCII codes and their format and number of digits are determined by the type of command. The number of digits of each command is shown in Table 5-5.

When there is a 0 to the left of valid data, (space) is sent, (comma) is inserted between data as a delimiter, and a terminator is sent at the end of the last data.

EOI is sent together with the terminator with the GP-IB.

Command	Digits	Format type
READ STATUS WORD 1	5	1
READ STATUS WORD 2	5	1
READ STATUS WORD 3	1	1
READ OFFSET	6	2
READ LOWER LEFT	6	2
READ UPPER RIGHT	6	2
GIN	6	3
CALL GIN	6	3

Table 5-5 Number of digits and format type of output data

a) Format type 1

Data	Terminator (T)
------	----------------

Example)

 1664 (T) (READ STATUS WORD 1)
 166432 (T) (READ STATUS WORD 2)
 1 (T) (READ STATUS WORD 3)

b) Format type 2

Data	Delimiter	Data	Terminator
------	-----------	------	------------

Example)

 ▯▯2000,▯▯▯1000 (T)

 ▯-1000,▯▯▯-500 (T)

c) Format type 3

Data	Delimiter	Data	Delimiter	Data	Terminator
------	-----------	------	-----------	------	------------

Example)

 ▯▯1000,▯▯▯500,▯▯▯▯10 (T)

 ▯▯-500,▯▯▯-10,▯▯▯▯21 (T)

2) 2 byte binary data format

Data output from plotter is in binary format when the READ command is in binary format. Output data consists of 2 bytes representing in binary first the more significant byte and then the less significant byte. Negative numbers are expressed in complementary notation. The format type depends on the type of command as shown in Table 5-5.

a) Format type 1

Data	
More significant byte	Less significant byte

Example)

(06)₁₆ (80)₁₆

(00)₁₆ (20)₁₆

b) Format type 2

Data		Data	
More significant byte	Less significant byte	More significant byte	Less significant byte

Example)

(2A)₁₆ (F8)₁₆ (1D)₁₆ (D8)₁₆

c) Format type 3

Data		Data		Data	
More significant byte	Less significant byte	More significant byte	Less significant byte	More significant byte	Less significant byte

Example)

$(FE)_{16}$ $(0C)_{16}$ $(FF)_{16}$ $(F6)_{16}$ $(00)_{16}$ $(15)_{16}$

5.4 Commands and Statements

o Command bytes

Command byte		Command	Command type	Reference
Character	$(X)_{10}$ Code $(X)_8$			
/	33 (21) ₁₆ 41 ₈	SPEED	1	5.4.27
"	37 (22) ₁₆ 42 ₈	ERROR MASK	1	5.4.43
#	35 (23) ₁₆ 43 ₈	READ STATUS WORD 3	4	5.4.42 *
\$	36 (24) ₁₆ 44 ₈	FONT	1	5.4.11
%	37 (25) ₁₆ 45 ₈	HATCHING	1	5.4.22
&	38 (26) ₁₆ 46 ₈	FACTOR	1	5.4.28
,	39 (27) ₁₆ 47 ₈	not used	-	-
(	40 (28) ₁₆ 50 ₈	USER'S PATTERN (option)	2	5.4.10
:	5B (3A) ₁₆ 72 ₈	CLEAR	4	5.4.33
;	59 (3B) ₁₆ 73 ₈	INTERFACE CLEAR	4	5.4.34
<	60 (3C) ₁₆ 77 ₈	not used	-	-
=	61 (3D) ₁₆ 75 ₈	TERM	5	5.4.32
>	62 (3E) ₁₆ 76 ₈	not used	-	-
?	63 (3F) ₁₆ 77 ₈	READ OFFSET	4	5.4.39 *
@	64 (40) ₁₆ 80 ₈	READ STATUS WORD 2	4	5.4.41 *
A	65 (41) ₁₆ 81 ₈	ALPHA RESET	4	5.4.16
B	66 (42) ₁₆ 82 ₈	LINE SCALE	1	5.4.6
C	67 (43) ₁₆ 83 ₈	CALL GIN	4	5.4.36 *
D	68 (44) ₁₆ 84 ₈	DRAW	2	5.4.1
E	69 (45) ₁₆ 85 ₈	RELATIVE DRAW	2	5.4.2

Command byte		Command	Command type	Reference
Character	(X) ₁₆ Code (X) ₈			
F	70 (46) ₁₆ 80	CHART FEED (valid only with paper feeding mechanism)	1	5.4.24
G	71 (47) ₁₆ 82	GIN*	4	5.4.35 *
H	72 (48) ₁₆ 80	HOME	4	5.4.23
I	73 (49) ₁₆ 81	ALPHA ITALIC	1	5.4.15
J	74 (4A) ₁₆ 82	NEW PEN (valid only with multipen)	1	5.4.25
K	75 (4B) ₁₆ 83	KANA (Greek)	3	5.4.8
L	76 (4C) ₁₆ 84	LINE TYPE	1	5.4.5
M	77 (4D) ₁₆ 85	MOVE	1	5.4.3
N	78 (4E) ₁₆ 86	MARK	1	5.4.9
O	79 (4F) ₁₆ 87	RELATIVE MOVE	1	5.4.4
P	80 (50) ₁₆ 100	PRINT	3	5.4.7
Q	81 (51) ₁₆ 101	ALPHA SPACE	1	5.4.13
R	82 (52) ₁₆ 102	ALPHA ROTATE	1	5.4.14
S	83 (53) ₁₆ 103	ALPHA SCALE	1	5.4.12
T	84 (54) ₁₆ 104	PROMPT LIGHT	1	5.4.26
U	85 (55) ₁₆ 105	READ UPPER RIGHT	4	5.4.38 *
V	86 (56) ₁₆ 106	READ STATUS WORD 1	4	5.4.40 *
W	87 (57) ₁₆ 107	CIRCLE	1	5.4.17
X	88 (58) ₁₆ 110	AXIS	1	5.4.21
Y	89 (59) ₁₆ 111	CURVE	2	5.4.19
Z	90 (5A) ₁₆ 112	WRITE UPPER RIGHT	1	5.4.30
[	91 (5B) ₁₆ 113	READ LOWER LEFT	4	5.4.37 *
\ (¥)	92 (5C) ₁₆ 114	WRITE LOWER LEFT	1	5.4.29
]	93 (5D) ₁₆ 115	RELATIVE CIRCLE	1	5.4.18
↑ (^)	94 (5E) ₁₆ 116	OFFSET	1	5.4.31
← (_)	95 (5F) ₁₆ 117	RELATIVE CURVE	2	5.4.20

Note:

Characters in parentheses are JIS characters.

READ commands (marked *) and CLEAR, INTERFACE CLEAR commands cannot be used with the 8 bit parallel interface.

5.4.1 DRAW

Command format	Format
ASCII	$Dx_1, y_1, x_2, y_2, \dots, x_n, y_n (T)$
Binary	8044 $x_1, y_1, x_2, y_2, \dots, x_n, y_n$ (See note below.)

Note: In this case, the next command "80XX" serves as the terminator (80XX cannot be the same value as X_n since it has to be less than -32512 in binary.)

Draws straight lines starting from the current pen position (x_n, y_n) and connecting in succession the absolute coordinates specified.

Refer to section 5.4.5 LINE TYPE for the types of line.

The coordinate value is expressed as an integral multiple of GDU relative to the OFFSET position.

If the specified coordinate values are out of the valid plotting area, the pen draws the line up to the edge of the valid plotting area, lifts, moves to the point where the line connecting the specified coordinates next enters the valid plotting area, comes down there and restarts drawing.

This is so in all plotting to be explained hereafter. When a character is plotted near the border of the valid plotting area, the parts of the character which exceed the valid plotting area, if any, will be omitted.

Example 1: D500, 500, 500, 1500, 2500, 2500 (T)

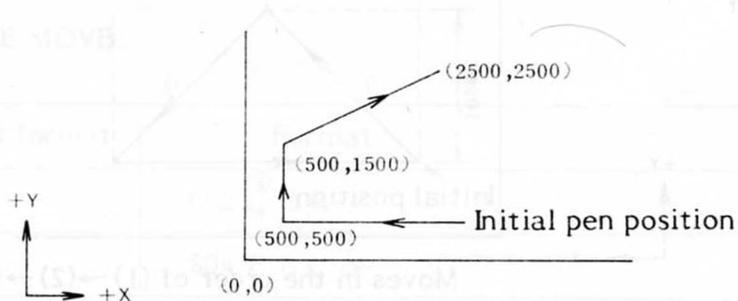


Fig. 5-2 DRAW 1

Example 2: D500, 500, -500, 1000, -500, 2000, 2000, 2500 (T)

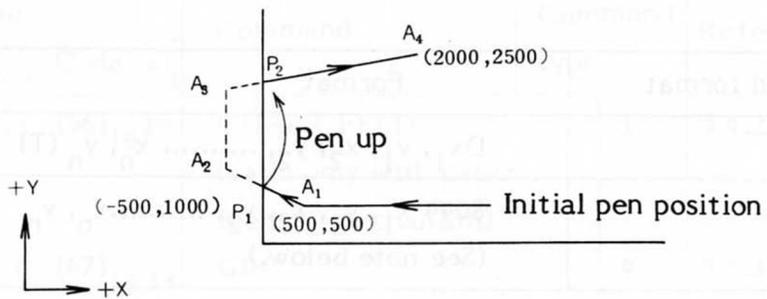


Fig. 5-3 DRAW 2.

If $A_1 \rightarrow A_2 \rightarrow A_3 \rightarrow A_4$ is specified and A_2, A_3 are out of the valid plotting area, the pen will move $A_1 \rightarrow P_1 \rightarrow P_2 \rightarrow A_4$. A line is not drawn between P_1 and P_2 .

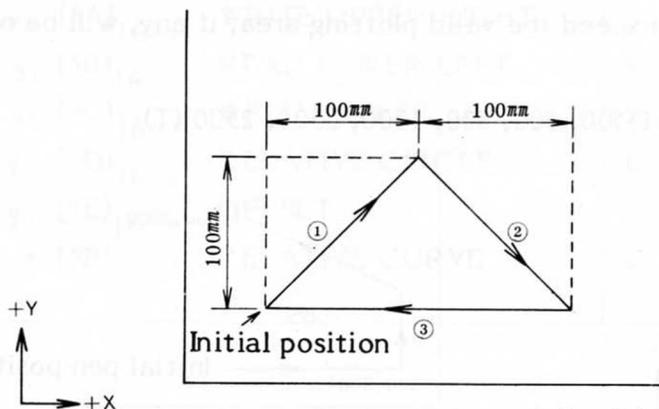
5.4.2 RELATIVE DRAW

Command format	Format
ASCII	E $\Delta x_1, \Delta y_1, \Delta x_2, \Delta y_2, \dots, \Delta x_n, \Delta y_n$ (T)
Binary	8045 $\Delta x_1 \Delta y_1 \Delta x_2 \Delta y_2 \dots \Delta x_n \Delta y_n$

This command is the same as the DRAW command except that the coordinates are specified relative to the current pen position instead of as absolute coordinates.

$\Delta x, \Delta y$ indicate the distance from the current position in the respective directions. They are expressed as positive or negative integral multiples of the GDU.

Example 1: E1000, 1000, 1000, -1000, -2000, 0 (T)



Moves in the order of (1) \rightarrow (2) \rightarrow (3)

Fig. 5-4 RELATIVE DRAW

5.4.3 MOVE

Command format	Format
ASCII	M x, y
Binary	804 D xy

This command moves the pen from the current position to coordinates (x, y) with the pen raised. Coordinate values (x, y) are expressed as integral multiples of the GDU relative to the OFFSET position.

If a series of MOVE commands are input, the pen moves only to the point specified by the last one. This command is used mainly at the start of drawing of straight lines and characters.

Example : M500, 600

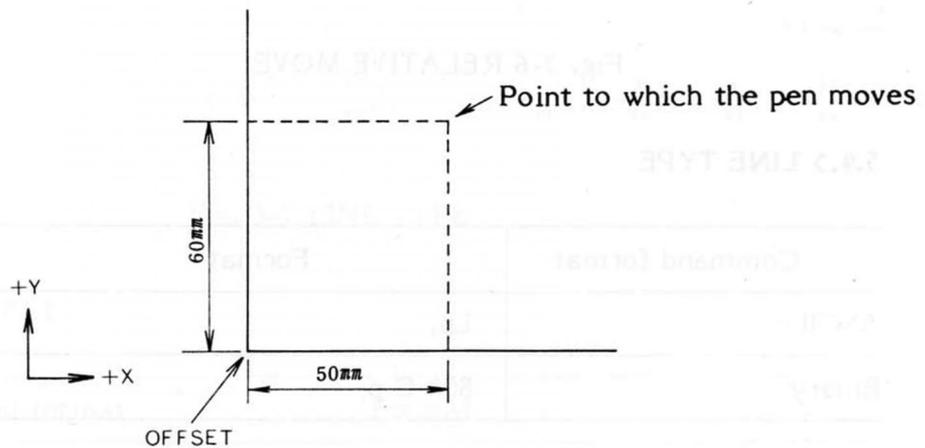


Fig. 5-5 MOVE

5.4.4 RELATIVE MOVE

Command format	Format
ASCII	O Δx, Δy,
Binary	804 F Δx Δy

This command is the same as MOVE except that the coordinates are specified relative to the current pen position instead of as absolute coordinates.

Δx , Δy indicate the distance from the current pen position in the respective directions. They are expressed as positive or negative integral numbers whose unit is GDU.

Example: O 100, 100,

Pen moves 100 GDU (=10 mm) in the directions of the X and Y axes from the current position.

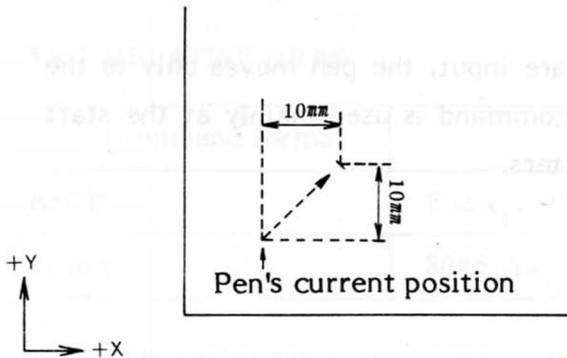


Fig. 5-6 RELATIVE MOVE

5.4.5 LINE TYPE

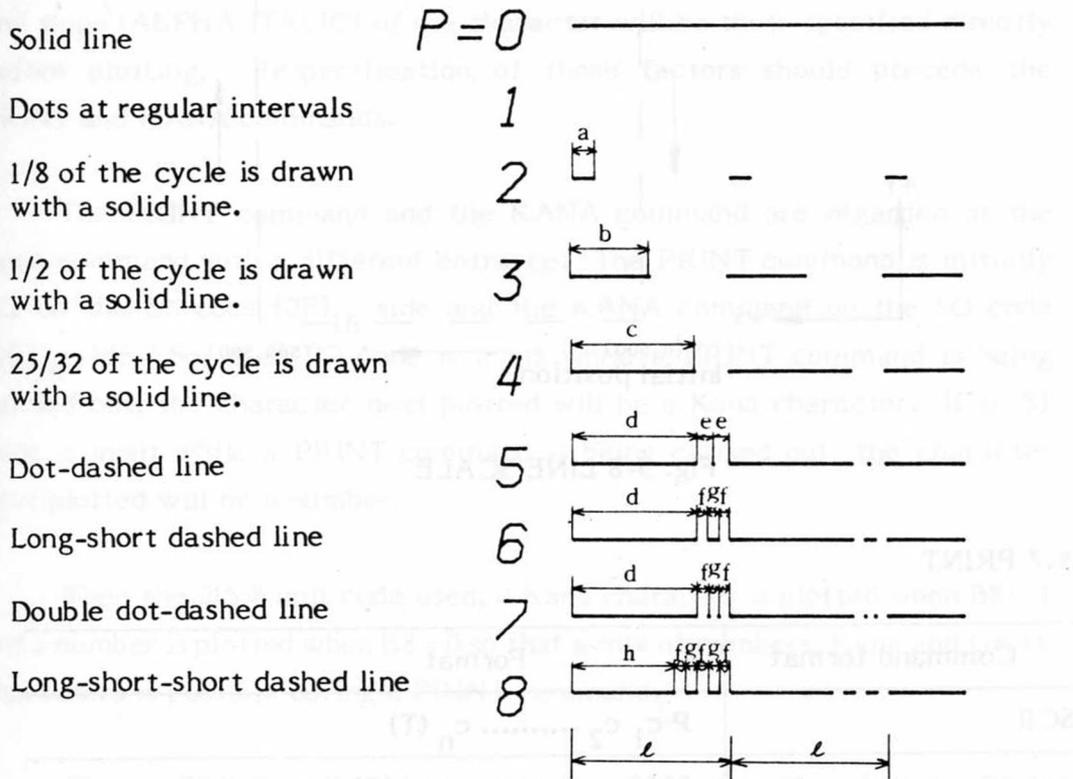
Command format	Format
ASCII	Lp,
Binary	804 C p.

This command specifies the type of line. All the lines are drawn as specified. If not specified, a solid line is drawn.

The length of "l" in Fig. 5-7 below is specified as in 5.4.6 LINE SCALE.

Note: Do not command P = 1, 5, 7 when drawing with a ball-point pen.

LINE TYPE



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

Fig. 5-7 LINE TYPE

5.4.6 LINE SCALE

Command format	Format
ASCII	B <i>l</i>
Binary	8042 <i>l</i>

This command specifies the cycle length of broken lines. If not specified, $l = 100$ (10 mm).

Example: B 100, L 3, D 500, 500, 500, 1000, 0, 1000, 0, 500 (T)

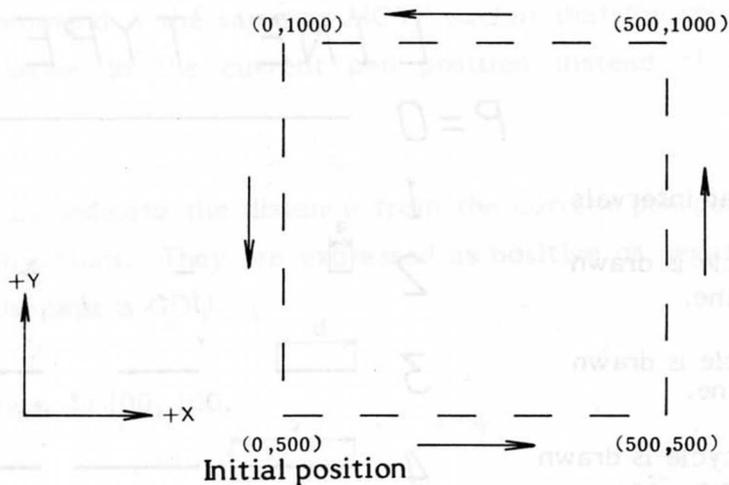


Fig. 5-8 LINE SCALE

5.4.7 PRINT

Command format	Format
ASCII	P c ₁ c ₂ c _n (T)
Binary	8050 c ₁ c ₂ .....c _n (T)

Refer to the explanation in the "KANJI" section below.

5.4.8 KANA (GREEK)

Command format	Format
ASCII	K c ₁ c ₂ .....c _n (T)
Binary	804 B c ₁ c ₂ .....c _n (T)

The PRINT command plots ASCII characters.

The KANA command plots Katakana and Greek characters. ASCII code and JIS 7 unit code, or JIS 8 unit code are used.

The characters to be plotted in the above 2 commands are selected by the FONT command, for which refer to the code chart at the end of this manual.

Plotting starts from the lower left of the first character. The scale (ALPHA SCALE), spacing (ALPHA SPACE), rotation (ALPHA ROTATE), and slope (ALPHA ITALIC) of the character will be those specified directly before plotting. Respecification of these factors should precede the PRINT and KANA commands.

The PRINT command and the KANA command are regarded as the same command with a different entrance. The PRINT command is initially set on the S1 code (0F)₁₆ side and the KANA command on the SO code (0E)₁₆ side. So, if an SO code is input while a PRINT command is being carried out, the character next plotted will be a Kana character. If an S1 code is input while a PRINT command is being carried out, the character next plotted will be a number.

When the JIS 8 unit code used, a Kana character is plotted when B8 = 1 and a number is plotted when B8 = 0 so that a mix of numbers, Kana and Greek characters is possible during a PRINT command.

When a PRINT or KANA command is set on the SO code side, B8 is always handled as "1".

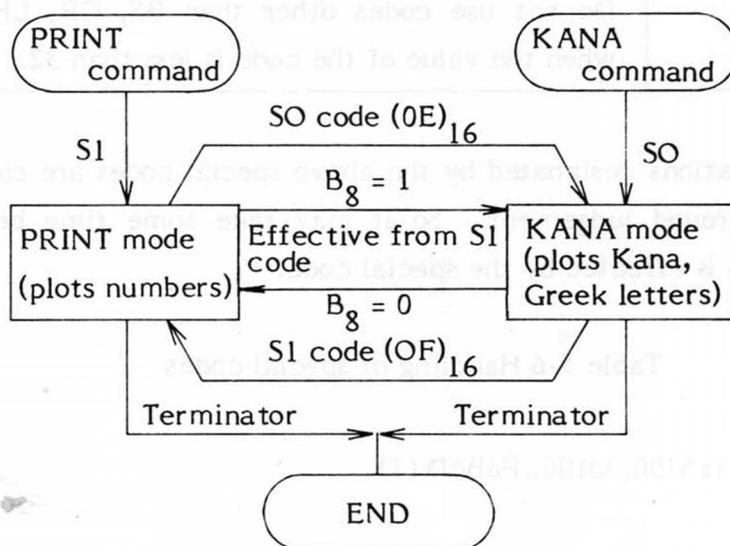


Fig. 5-9 PRINT, KANA change-over diagram

Notes:

When numbers and Kana (Greek) characters are mixed, character spacing is not even since the character pattern of numbers is 7 x 4 while that of Kana characters is 7 x 6. So it is necessary to specify adequate spacing by ALPHA SPACE commands in advance.

Some of the numbers and Greek characters extend further than others on the lower side (refer to the Pattern Chart). If those characters or numbers are plotted at the border of the valid plotting area, part of them (which exceeds the valid plotting area) will be omitted.

BS (Back Space)	The pen back spaces by one character (scale, orientation, slope as specified). *
CR (Carriage Return)	The pen moves to the lower left corner of the first character in the current line. *
LF (Line Feed)	The pen position moves down by the specified line space. The line space is 1.5 times the height of the character specified by the ALPHA SCALE command.
Bell, VT, FF, etc.	Do not use codes other than BS, CR, LF, S1, S0 when the value of the code is less than 32.

* Note:

The operations designated by the above special codes are carried out upon all-round judgement. So it may take some time before the operation is effected by the special code.

Table 5-6 Handling of special codes

Example 1: S100, Q100, PaBcD (T)

a B c D

Fig. 5-10 PRINT 1

Example 2: S100, Q100, K ワタナベソ ッキ (T)

Plots ワタナベソ ッキ, (T) terminates the KANA command.

ワタナベソ ッキ

Fig. 5-11 KANA

Example 3: M1000, 1000, PABC (T)

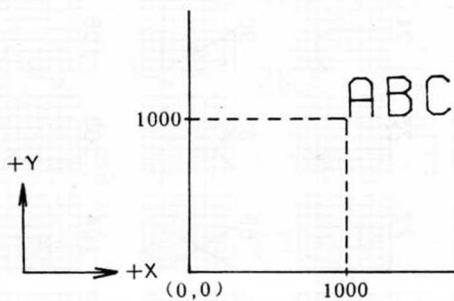


Fig. 5-12 PRINT 2

32		33	!	34	W	35	H	36	S	37	/	38	8	39	V	40	U	41	J	42	X	43	H	44	9	45	=	46	□	47	/
48	0	49	1	50	Z	51	3	52	4	53	5	54	6	55	/	56	8	57	9	58	□	59	9	60	<	61	=	62	>	63	2
64	0	65	A	66	B	67	C	68	D	69	E	70	F	71	G	72	H	73	I	74	J	75	K	76	L	77	M	78	N	79	O
80	P	81	Q	82	R	83	S	84	T	85	U	86	V	87	W	88	X	89	Y	90	Z	91	.	92	/	93	┘	94	↑	95	←
96	N	97	α	98	o	99	e	100	a	101	e	102	f	103	g	104	n	105	l	106	j	107	k	108	l	109	m	110	n	111	o
112	P	113	o	114	Y	115	S	116	t	117	u	118	V	119	W	120	X	121	Y	122	Z	123	┘	124	┘	125	┘	126	┘	127	┘

Table 5-7 Character pattern chart (1/4)

Table 5-7 Character pattern chart (2/4)

	35	36	
FONT \$0,			
FONT \$1,			
FONT \$2,			
FONT \$3,			
FONT \$4,			
FONT \$5,			
FONT \$6,			
FONT \$7,			
FONT \$8,			
FONT \$9,			

64	91	92	93	94	95	123	124	125	126

144		145	□	146	△	147	Z	148	⊕	149	Λ	150	⊥	151	⊙	152	⊥	153	Σ	154	⊥	155	⊙	156	⊙	157	⊙	158		159	
160		161	○	162	┌	163	└	164	∨	165	□	166	⊥	167	⊥	168	⊥	169	⊥	170	⊥	171	⊥	172	⊥	173	⊥	174	⊥	175	⊥
176	—	177	Y	178	⊥	179	⊥	180	⊥	181	⊥	182	⊥	183	⊥	184	⊥	185	⊥	186	⊥	187	⊥	188	⊥	189	⊥	190	⊥	191	⊥
192	⊥	193	⊥	194	⊥	195	⊥	196	⊥	197	⊥	198	⊥	199	⊥	200	⊥	201	⊥	202	⊥	203	⊥	204	⊥	205	⊥	206	⊥	207	⊥
208	⊥	209	△	210	⊥	211	⊥	212	⊥	213	⊥	214	⊥	215	⊥	216	⊥	217	⊥	218	⊥	219	⊥	220	⊥	221	⊥	222	⊥	223	○
224		225	α	226	β	227	γ	228	δ	229	ε	230	ζ	231	η	232	θ	233	ι	234	κ	235	λ	236	μ	237	ν	238	ξ	239	ο
240	π	241	ρ	242	σ	243	τ	244	υ	245	φ	246	χ	247	ψ	248	ω	249	≤	250	≥	251	±	252	∅	253	∞	254	∞	255	

Table 5-7 Character pattern chart (3/4)

160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175
176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191
192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207
208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223
224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239
240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255

Table 5-7 Character pattern chart (4/4)

5.4.9 MARK

Command format	Format
ASCII	Nn,
Binary	804 En

This command draws the following symbols centered on the pen position. Convenient for plotting the measurement points of graphs, etc.
 $n = 0 - 15$

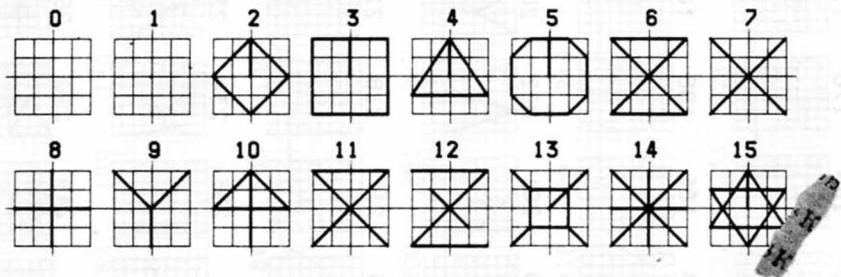


Fig. 5-13 MARK

Notes:

The scale, orientation and slope of the above symbols are defined respectively by the ALPHA SCALE, ALPHA ROTATE and ALPHA ITALIC commands specified just before (except for $n = 0, 1$). The height of the symbol, however, will be $4/7$ of the scale in the PRINT, KANA commands.

Example:

When n of the ALPHA SCALE command just before the MARK command is designated as 140, the height of the symbol will be 8 mm.

S140, N3,

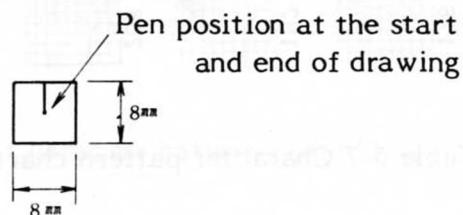


Fig. 5-14 Size of MARK

5.4.10 USER'S PATTERN

Command format	Format
ASCII	(n_1, n_2, \dots, n_k (T)
Binary	8028 $n_1 n_2 \dots n_k$

$$n = 16 - 254$$

This command is effective when an optional ROM is incorporated in the plotter to plot the user's pattern. The user's pattern specified by the user and written in the ROM is drawn by this command.

The size, slope, rotation, etc. of the patterns are specified by ALPHA SCALE, ALPHA SPACE, ALPHA ITALIC and ALPHA ROTATE.

Out of the parameters $n = 0 - 15$, only 8, 10 and 13 can be used.

$n = 8$ BACK SPACE (BS)
 $n = 10$ LINE FEED (LF)
 $n = 13$ CARRIAGE RETURN (CR)

- o Method of drawing up letter patterns (within ROM in plotter)

Entered as a link between the coordinates of 2 - 254 together with X, Y as the origin (128, 128) of the letter pattern (2-byte units).

Special codes:

X = 255, Y = 255 Pattern table end
 X = 255 Y = code NO. Begin one pattern (No. 16 - 254)
 X = 0 Y = 0 Ignore (2 bytes)
 X = 0 Y = 1 PEN UP (up to the next point)
 X = 1 NESTING (See note 1.)

With the letter size, 63 relates to the size in the PRINT command.

Note: The NESTING pattern can be used with 4-byte units when using the common pattern and the pattern supplement, etc.

X	Low rank	High rank	N
---	----------	-----------	---

Address

X = 1

N = 0 ... PATTERN JMP

N ≠ 0 ... PATTERN CALL

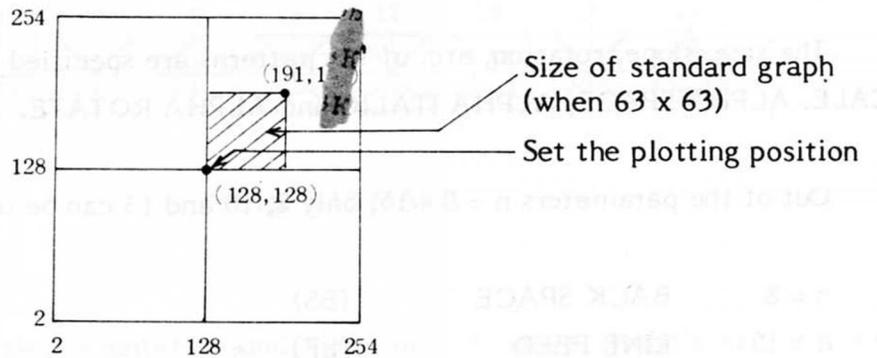


Fig. 5-15 Area in which the pattern can be drawn

Plotting example 1

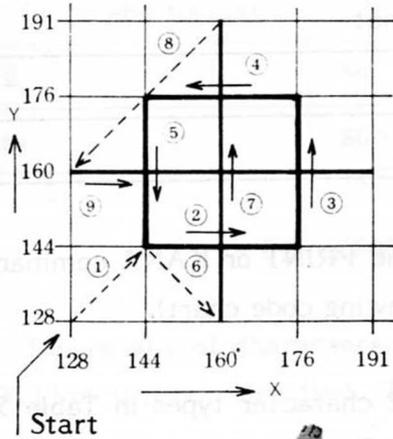


Fig. 5-16 Example of pattern plotting

ROM Address	(X)	(Y)	
00H	255	100	Start pattern code No. 100
02H	0	1	Pen up
04H	144	144	[112, 112]
06H	176	144	[144, 112]
08H	176	176	[144, 144]
0AH	144	176	[112, 144]
0CH	144	144	[112, 112]
0EH	0	1	Pen up
10H	160	128	[128, 96]
12H	160	191	[128, 160]
14H	0	1	Pen up
16H	128	160	[96, 128]
18H	191	160	[160, 128]
1AH	255	□	← NEXT code

Note 2:

Center is the zero position when using the figures shown in parentheses

Note 3:

- > Shows pen up movement
- > Shows pen down movement

Figures in circles shows the sequence of pen movement.

Plotting example 2

When plotting Kanji [技, 枝, 松]

ROM Address	(X)	(Y)	
00H	255	20	.....技 pattern (No=20)
02H	1	80H, 04H, 1	..... (CALL 技 pattern)
06H	1	10H, 00H, 0	..... (JMP 支 pattern)
< CALL could be possible >			
0AH	255	30	.....枝 pattern (No=30)
0CH	1	A0H, 04H, 1	..... (CALL 技 pattern)
10H			支 pattern
	255	31	.....松 pattern (No=31)
	1	A0H, 04H, 1	..... (CALL 技 pattern)
			松 pattern
	255	□	..... NEXT pattern
			}
	255	255	..... Table finished
			}
0480H			技 pattern
	255	0	
04A0H			技 pattern
	255	0	
			}

5.4.11 FONT

Command format	Format
ASCII	\$ n,
Binary	8024 n

The character code to be plotted by the PRINT or KANA commands is specified by parameter n (refer to the following code chart).

The letters belonging to each of the 12 character types in Table 5-8 are expressed (and selected) by parameter n. The use of Kana characters is also selectable.

Parameter (n)	Country	Code position											
		2/3	2/4	4/0	5/8	5/C	5/D	5/E	5/F	7/B	7/C	7/D	7/E
0	STANDARD	#	\$	@	[	\	\]	↑	←	{	|	}	~
1	ISO	#	☒	@	[	\	\]	^	_	{	|	}	-
2	Japan	#	\$	@	[	¥	]	^	_	{	|	}	-
3	U. S. A.	#	\$	@	[	\	\]	^	_	{	|	}	~
4	England	£	\$	@	[	\	\]	↑	_	{	|	}	-
5	Germany	£	\$	§	Ä	Ö	Ü	^	_	ä	ö	ü	ß
6	France	£	\$	a	○	Ç	§	^	_	e	u	e	..
7	Sweden	£	\$	@	Ä	Ö	Å	^	_	ä	ö	å	-
8	Denmark	£	\$	@	Æ	Ø	Å	^	_	æ	Ø	å	-
9	Spain	£	\$	@	i	Ñ	¿	^	_	{	ñ	}	-

Table 5-8 FONT chart

Notes:

n = 0 - 9: Numbers and symbols in accordance with the above FONT chart. Both Kana and Greek characters are drawn.

n = 10 - 19: Numbers and symbols the same as in the above n = 0 - 9. Kana letters cannot be drawn but the types of Greek letters are increased.

(Refer to the code chart at the end of the manual.)

Initial setting is n = 0

5.4.12 ALPHA SCALE

Command format	Format
ASCII	S_n
Binary	$8053 n$

$$0 \leq n \leq 8000$$

The height of characters is specified in integral multiples of GDU. $n = 30$ (3 mm) if not specified. The width of the characters is $n \times 4/7$.

Example 1: S50, PABC (T)

The height of letters plotted by the PRINT command after this command is 5 mm.

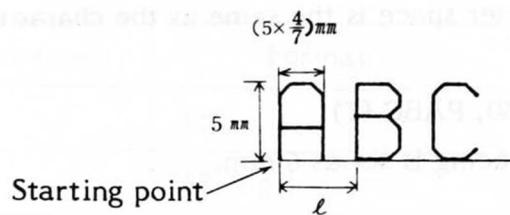


Fig. 5-17 ALPHA SCALE 1

Example 2: S50, Kアイ (T)

Note: l is set in accordance with the specification of ALPHA SPACE.

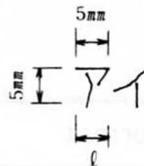


Fig. 5-18 ALPHA SCALE 2

5.4.13 ALPHA SPACE

Command format	Format
ASCII	$Ql,$
Binary	8051 <i>l</i>

$$0 \leq l \leq 8000$$

This command specifies in integral multiples of GDU the space between the starting point of the letter and the starting point of the next letter.

Note: When the size of the characters is large, the character spacing should be wide too. Otherwise the characters plotted may overlap.

Usually the character space is the same as the character scale.

Example: Q60, S60, PABC (T)

Character spacing is set as 6 mm.

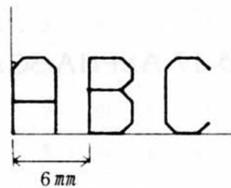


Fig. 5-19 ALPHA SPACE

5.4.14 ALPHA ROTATE

Command format	Format
ASCII	$R \theta$
Binary	8052 θ

$$-32767 \leq \theta \leq 32767$$

This command is used to rotate characters and lines. If not otherwise specified, it is set at 0. θ is defined in integral multiples of 0.1° . The angles are measured positively in the anticlockwise direction from the X positive axis and measured negatively in the clockwise direction from the same.

Example: R300, PABC (T)

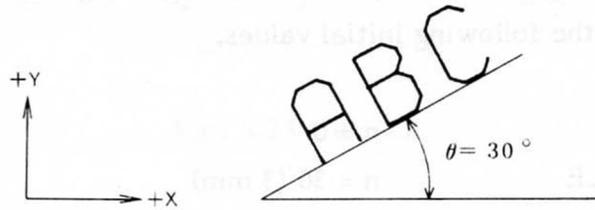


Fig. 5-20 ALPHA ROTATE

5.4.15 ALPHA ITALIC

Command format	Format
ASCII	I p,
Binary	8049 p

$$p = 256 \tan \theta \quad (-4000 \leq p \leq 4000)$$

This command inclines the characters. If not otherwise specified, the angle (p) is set to 0. θ is the angle from the Y axis.

Example: I256, PA (T)

The inclination of characters with this command is as follows.

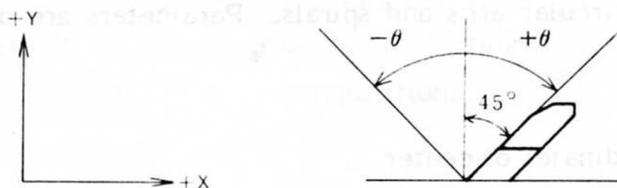


Fig. 5-21 ALPHA ITALIC

5.4.16 ALPHA RESET

Command format	Format
ASCII	A
Binary	8041

This command returns the parameters regarding the character and symbol settings to the following initial values.

FONT	$n = 0$
ALPHA SCALE	$n = 30$ (3 mm)
ALPHA SPACE	$\ell = 30$ (3 mm)
ALPHA ROTATE	$\theta = 0$
ALPHA ITALIC	$p = 0$

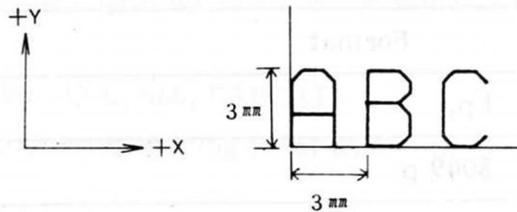


Fig. 5-22 ALPHA RESET

5.4.17 CIRCLE

Command format	Format
ASCII	W $x_0, y_0, r_1, r_2, \theta_1, \theta_2$,
Binary	8057 $x_0 y_0 r_1 r_2 \theta_1 \theta_2$

Draws circles, circular arcs and spirals. Parameters are defined as follows:

x_0, y_0 :	Coordinates of center
r_1, r_2 :	Initial and final radii (integral multiples of GDU)
θ_1, θ_2 :	Initial and final angles (integral multiples of 0.1°)

The angles are measured positively in the anticlockwise direction from the X positive axis and negatively in the clockwise direction from the same.

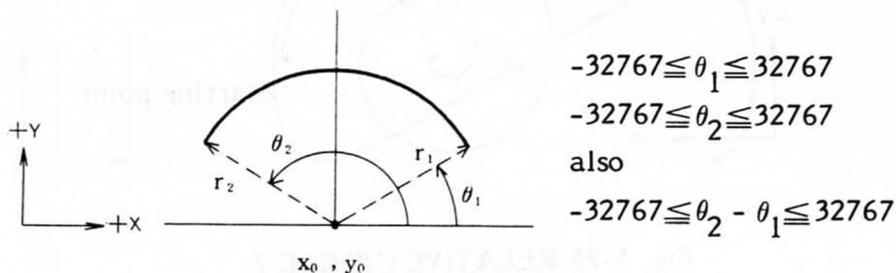


Fig. 5-23 CIRCLE

5.4.18 RELATIVE CIRCLE

Command format	Format
ASCII	]r ₁ , r ₂ , θ ₁ , θ ₂ ,
Binary	805 D r ₁ r ₂ θ ₁ θ ₂

Draws circles, circular arcs and spirals starting from the current pen position.

- r₁, r₂: Initial and final radii (integral multiples of GDU)
- θ₁, θ₂: Initial and final angles (integral multiples of 0.1°)

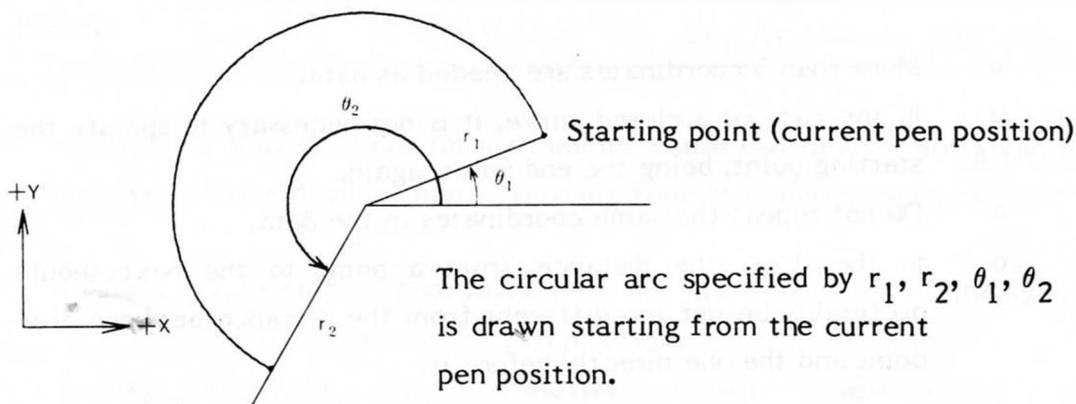


Fig. 5-24 RELATIVE CIRCLE 1

Example:]200, 0, 0, 7200

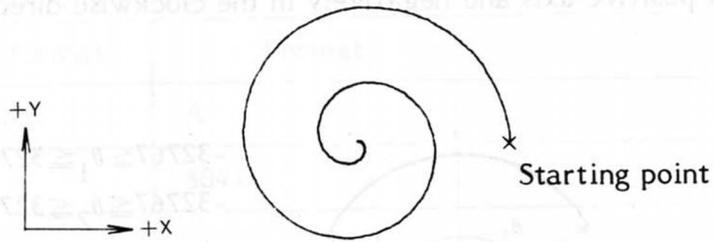


Fig. 5-25 RELATIVE CIRCLE 2

5.4.19 CURVE

Command format	Format
ASCII	Y a, $x_1, y_1, x_2, y_2, \dots, x_n, y_n$ (T)
Binary	8059 a $x_1 y_1 x_2 y_2 \dots x_n y_n$

Draws a smooth curve through the points with coordinates x_n, y_n .

x_1, y_1 : Starting point of curve

$x_2, y_2 - x_n, y_n$: Consecutive coordinates of the curve

a = 0 Open curve

a = 1 Closed curve

Notes:

- o More than 3 coordinates are needed as data.
- o In the case of a closed curve, it is not necessary to specify the starting point, being the end point, again.
- o Do not repeat the same coordinates in the data.
- o In the data, the distance from a point to the next should preferably be not too different from the distance between that point and the one directly before it.
- o For a closed curve, the actual starting and end point of the drawing is the second point given.

Example 1: Y 1, 500, 500, 500, 750, 1000, 500, 1000, 750 (T)

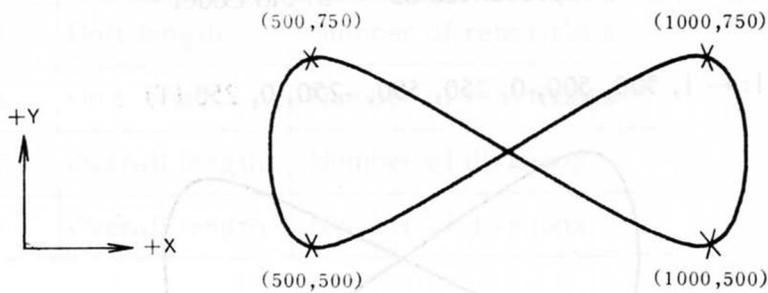


Fig. 5-26 CURVE 1

Example 2: Y 0, 500, 500, 700, 600, 1100, 400, 1300, 500 (T)

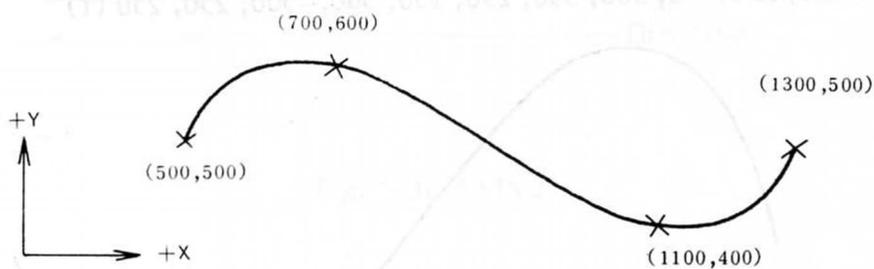


Fig. 5-27 CURVE 2

5.4.20 RELATIVE CURVE

Command format	Format
ASCII	$\leftarrow a, \Delta x_1, \Delta y_1, \Delta x_2, \Delta y_2, \dots, \Delta x_n, \Delta y_n (T)$
Binary	805 F a $\Delta x_1 \Delta y_1 \Delta x_2 \Delta y_2 \dots \Delta x_n \Delta y_n$

Draws a smooth curve through points whose coordinates are given by successive relative displacements, starting from the current pen position.

$\Delta x_1, \Delta y_1$: Relative coordinates of the starting point of the curve from the current pen position.

$\Delta x_2, \Delta y_2, \dots, \Delta x_n, \Delta y_n$: Relative direct displacements of successive points.

a = 0 Open curve

a = 1 Closed curve

Note: Same as notes in CURVE above.

The "←" character is represented as "-" in JIS code.

Example 1: ← 1, 500, 500, 0, 250, 500, -250, 0, 250 (T)

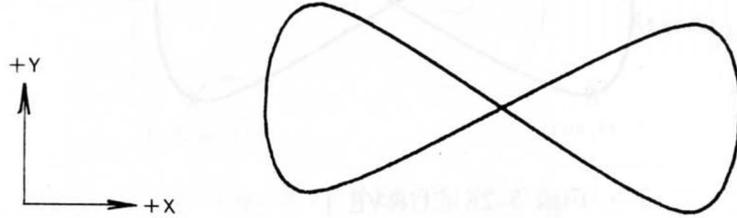


Fig. 5-28 RELATIVE CURVE 1

Example 2: ← 0, 500, 500, 250, 250, 500, -500, 250, 250 (T)

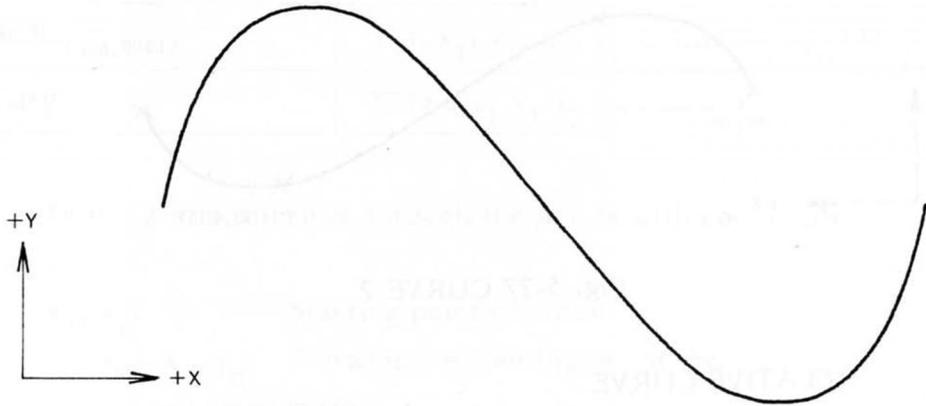


Fig. 5-29 RELATIVE CURVE 2

5.4.21 AXIS

Command format	Format
ASCII	X p, q, r,
Binary	8058 pqr

Draws a coordinate axis parallel to either the X or Y axis. The axis can be drawn both in the positive and negative directions. Parameter P represents the Y axis when it is 0 or 2, and the X axis when 1 or 3. The meaning of q and r is dependent on the value of p.

AXIS is drawn in a solid line regardless of the LINE TYPE command.

P	Axis	q	r
0	Y	Unit length	Number of repetitions
1	X	Unit length	Number of repetitions
2	Y	Overall length	Number of divisions
3	X	Overall length	Number of divisions

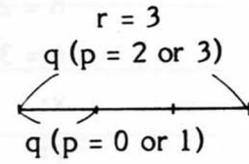


Fig. 5-30 AXIS 1

q is an integral multiple of the GDU.

Example 1: X 1, -200, 4, or X 3, -800, 4,

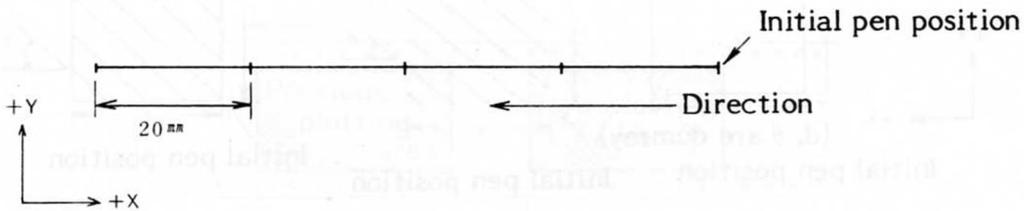


Fig. 5-31 AXIS 2

Example 2: X0, 100, 4, or X2, 400, 4,

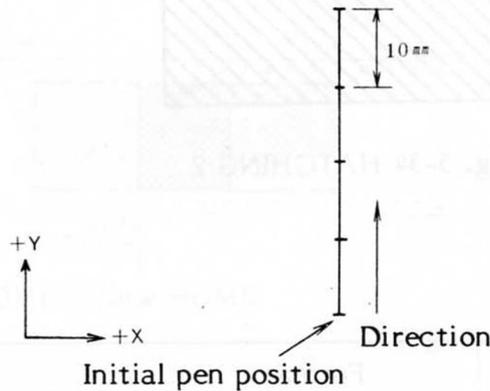


Fig. 5-32 AXIS 3

5.4.22 HATCHING

Command format	Format
ASCII	% n, x, y, d, θ ,
Binary	8025 nxyd θ

Draws rectangles parallel to the X and Y axes and also draws hatching.

- n = 1: Rectangles only
- n = 2: Hatching only
- n = 3: Rectangles and internal hatching
- x: Length in direction of X axis
- y: Length in direction of Y axis
- d: Hatching line spacing
- θ : Angle of hatching from X axis

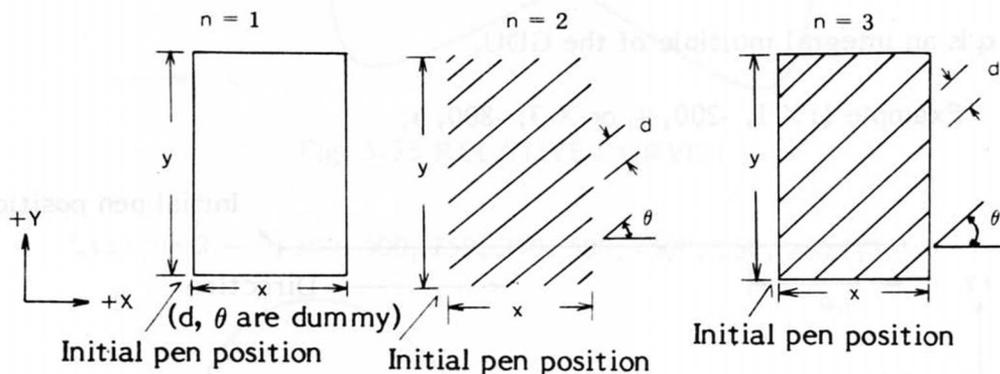


Fig. 5-33 HATCHING 1

Example: %3, 500, 200, 20, 450

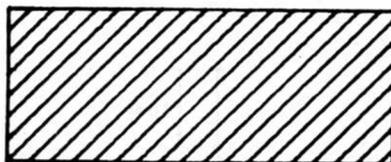


Fig. 5-34 HATCHING 2

5.4.23 HOME

Command format	Format
ASCII	H
Binary	8048

Moves with the pen raised to the HOME position. The HOME position is not influenced by the plotting area set. The HOME position may deviate from the original one if the plotter is initialized, due to the accuracy of the sensor to sense the machine origin.

5.4.24 CHART FEED

Command format	Format
ASCII	Fp,
Binary	8046p

Effective only when a chart feed mechanism is provided. P is a positive integral multiple of 0.1 mm. When P = 0 is specified, one page equivalent (same as p = 5000) is fed. ($0 \leq P \leq 32766$)

Example 1: F0,

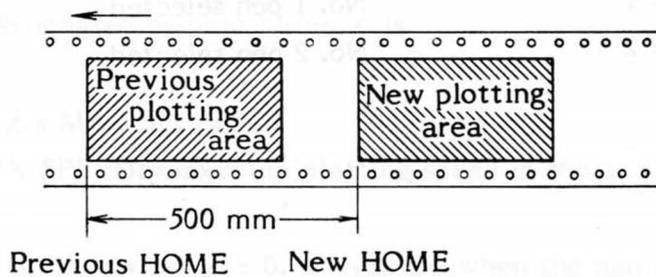


Fig. 5-35 CHART FEED 1

Example 2: F 2000,

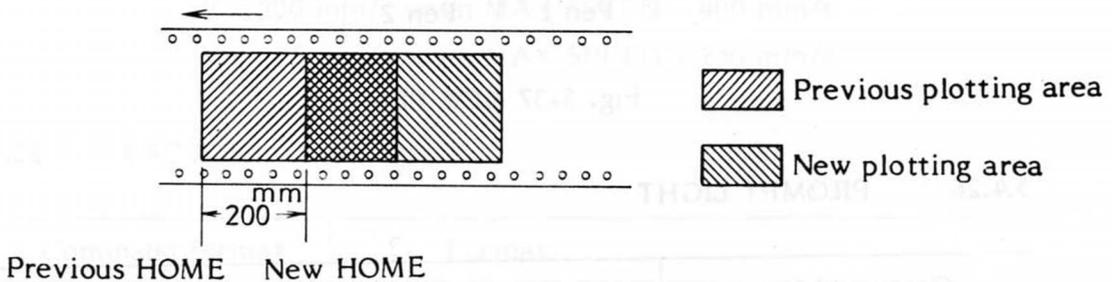


Fig. 5-36 CHART FEED 2

- o If a CHART FEED command is executed when the PAPER END lamp is on and CHART HOLD switch is at ON, the REMOTE and PROMPT lamps flash. If the ENTER switch is then pressed, the CHART FEED command is ignored and the drawing continues.

5.4.25 NEW PEN

Command format	Format
ASCII	Jn,
Binary	804A n

Effective with multipen (more than 2 pens) plotters. Pen specified by the parameter is automatically selected.

When plotter initialized	No. 1 pen selected
n = 1	No. 1 pen selected
n = 2	No. 2 pen selected
.	.
.	.
.	.

Example: M1000, 1000, J1, D1200, 1000(T) J2, D1400, 1000 (T)

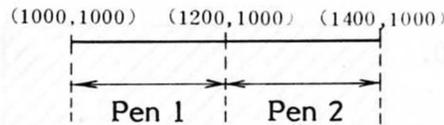


Fig. 5-37 NEW PEN

5.4.26 PROMPT LIGHT

Command format	Format
ASCII	T n,
Binary	8054 n

Turns on and off the PROMPT light on the operation panel. Used to draw the attention of the operator to the fact that the host controller is ready to receive input.

n = 0:	Off
n = 1:	On

5.4.27 SPEED

Command format	Format
ASCII	<i>!l,</i>
Binary	8021 <i>l</i>

Specifies the speed of pen in 10 stages when the pen is down.

$l = 1, 2, \dots, 10$ (Initial setting is $l = 10$)

Speed V designated by parameter l is

$$V \doteq l \times \text{MAX SPEED}/10$$

(MAX SPEED: maximum plotting speed in the axis direction)

V is MAX SPEED when $l = 0$. Pen speed when the pen is up is always MAX SPEED regardless of the speed set by SPEED command.

Example: *!5,*

$V = 200$ mm/s when MAX SPEED = 400 mm/s

$V = 125$ mm/s when MAX SPEED = 250 mm/s

5.4.28 FACTOR

Command format	Format
ASCII	& p, q, r,
Binary	8026 pqr

Specifies the plotting magnification. The coordinates, length, character size, etc. are multiplied by p/r , q/r . The value of OFFSET cannot be multiplied.

UPPER RIGHT, LOWER LEFT and CHART FEED are not influenced by FACTOR.

q, r are specified as follows:

p/r = magnification of X axis

q/r = magnification of Y axis

Initial setting is p/r = q/r = 1.

$0 < p, q, r \leq 32767$

$1/4096 < p/r, q/r < 8$

and,

coordinates before magnification by FACTOR x (p/r and q/r)
 $\leq |16383|$

Example: & 1, 2, 2,

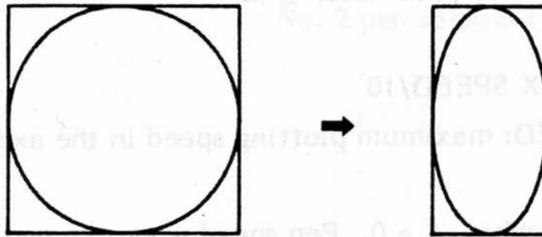


Fig. 5-38 FACTOR

5.4.29 WRITE LOWER LEFT

Command format	Format
ASCII	\x, y,
Binary	805 C xy

This is explained in the section "WRITE UPPER RIGHT" below. The "\" character is "¥" in the JIS codes.

5.4.30 WRITE UPPER RIGHT

Command format	Format
ASCII	Z x, y,
Binary	805 A xy

These commands specify the plotting area (LOWER LEFT, UPPER RIGHT) from the controller. X, Y are coordinates expressed in integral x, y are coordinate values expressed as integral multiples of 0.1 mm with the OFFSET point as the origin. The values of x, y are not influenced by FACTOR.

The initial setting of LOWER LEFT is (0, 0) and that of UPPER RIGHT is given by the maximum plotting area. Once the valid plotting area is specified by these commands, plotting outside the plotting area will not be carried out. By this means, part of a drawing can be omitted deliberately. For the plotting area, refer to section 6-4 Plotting Area and OFF SCALE Controls.

5.4.31 OFFSET

Command format	Format
ASCII	↑x, y,
Binary	805 E xy

Specifies the coordinates (x, y) as the origin. x, y are expressed in coordinates related to the HOME position as origin. The coordinates are specified as integral multiples of 0.1 mm within the range of:

$$-16383 \leq x, y \leq 16383$$

and

$$-16383 \leq x + X_0 \leq 16383 \quad X_0 = \text{Previous X coordinate OFFSET}$$

$$-16383 \leq y + Y_0 \leq 16383 \quad Y_0 = \text{Previous Y coordinate OFFSET}$$

"↑" is "^" in the JIS codes. Initial setting is the same as the HOME position.

Note: HOME position doesn't move.

FACTOR command has no effect.

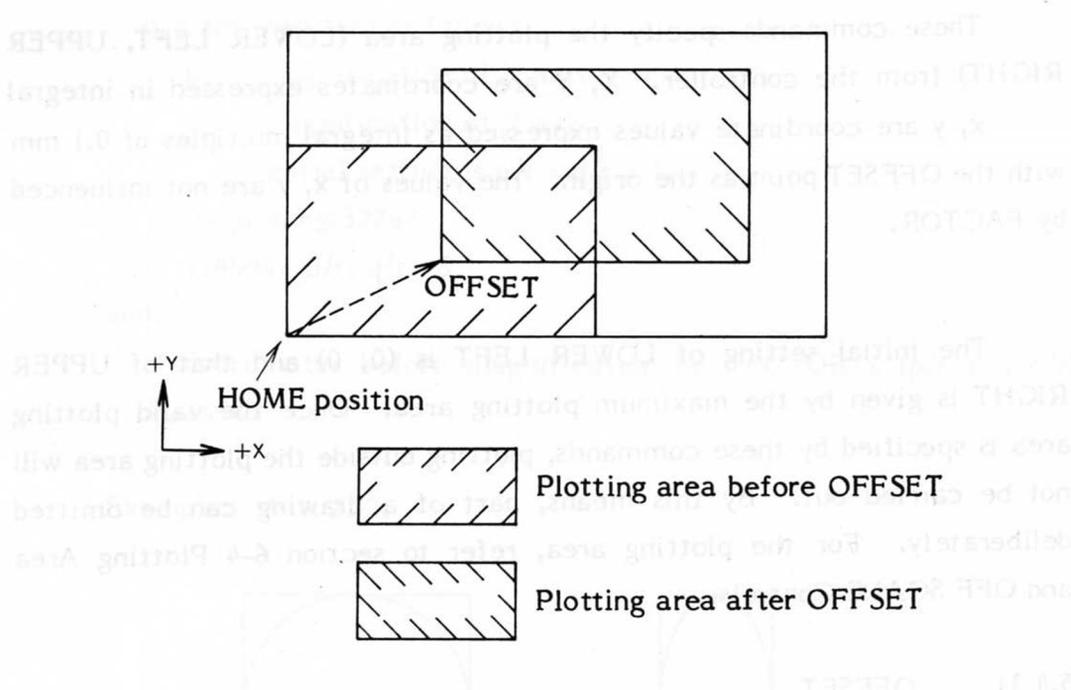


Fig. 5-39 OFFSET

5.4.32 TERM

Command format	Format
ASCII	= $t_1 t_2$
Binary	803 D $t_1 t_2$

A data terminator is specified by $t_1 t_2$ (2 characters). The characters specified by the TERM command are interpreted as terminator characters in the reception and transmission of data by the plotter.

1) Data reception

Either of the single characters t_1 and t_2 are interpreted as a terminator and also the sequence of two characters $t_1 t_2$.

2) Data transmission

In ASCII format, the sequence $t_1 t_2$ is appended to the end of transmitted data. When t_1 and t_2 are the same, 1 character only is attached.

Note that the characters t_1 and t_2 cannot be characters used as command bytes, the numerals 0 to 9 or "-" (minus sign) or $(60)_{16}$ - $(7F)_{16}$. The use of the codes $(00)_{16}$ - $(1F)_{16}$ is recommended.

Note: In the explanation of each command, the delimiter is represented by "," (comma) and the terminator by "ETX" (end of text).

Example 1: $(0D)_{16}$ $(0A)_{16}$

Terminator is either $(0D)_{16}$ or $(0A)_{16}$, or the 2 consecutive characters $(0D)_{16}$ $(0A)_{16}$. For data transmission, 2 characters $(0D)_{16}$ and $(0A)_{16}$ are appended to the end of the data.

Example 2: $(0D)_{16}$ $(0D)_{16}$

Terminator is $(0D)_{16}$. Only one character, $(0D)_{16}$, is attached to the transmitted data.

5.4.33 CLEAR

Command format	Format
ASCII	:
Binary	803 A

Note : Cannot be used with 8bit parallel interface.

Plotter is initialized immediately upon receipt of this command and all the settings are returned to the initial values (direct command). Please pause for at least 2 seconds between this and the next command.

5.4.34 INTERFACE CLEAR

Command format	Format
ASCII	;
Binary	803 B

Note : Cannot be used with 8bit parallel interface.

Immediately upon receipt of this command, data within buffer and I/O ERROR are cleared, terminator setting returns (ETX) and all interface control is initialized (direct command). However, the parameters of the following commands, which are already set, will be stored.

LINE TYPE
 LINE SCALE
 FONT
 ALPHA SCALE
 ALPHA SPACE
 ALPHA ITALIC
 ALPHA ROTATE
 WRITE LOWER LEFT
 WRITE UPPER RIGHT
 OFFSET
 FACTOR

Note: Please pause for at least 10 ms between this command and the next.

5.4.35 GIN

Command format	Format
ASCII	G
Binary	8047

Note: Cannot be used with 8 bit parallel interface.

This command asks for Graphic Input. That is, the coordinates of the pen position are digitized and sent to the host machine. When this command is sent, plotter transmits the current pen position in the same format as that shown in 5.4.35 CALL GIN.

Differences from CALL GIN are as follows.

Command	Format
GIN	Coordinates of the current pen position
CALL GIN	Coordinates of pen at the time ENTER switch is pressed.

5.4.36 CALL GIN

Command format	Format
ASCII	C
Binary	8043

Note: Cannot be used with 8 bit parallel interface.

This command asks for Graphic Input. The coordinates of the pen are digitized and read out by the host machine. When this command is sent, because the PROMPT light of the plotter is flashed, push the ENTER switch on the operation panel. The (x, y) coordinates and the state of the pen at that moment is transmitted to the host machine in the following format. The above (x, y) coordinates are influenced by the OFFSET and FACTOR commands.

During the flashing of the PROMPT lamp, the plotter enters the LOCAL mode and the key switches on the operation panel become effective so that the pen can be moved to the desired position before pressing the ENTER switch.

Format of data transmitted

X coordinate	Y coordinate	Pen state
MSD .....LSD,	MSD .....LSD,	nnns (T)

Example: 004280, 004270, 000011 (T)

Pen 1 is down.

In ASCII format, the output data is X coordinate, Y coordinate and pen state. The coordinate values are in 6-figure decimal notation. A zero on the left of a valid number outputs a space. As to the format of the output data, refer to the output data format in section 5.3.2.

Pen state is output as follows.

LLLL10	Pen 1 up
LLLL11	Pen 1 down
LLLL20	Pen 2 up
LLLL21	Pen 2 down
.	.
.	.
.	.

5.4.37 READ LOWER LEFT

Command format	Format
ASCII	[
Binary	805 B

Note: Cannot be used with 8 bit parallel interface.

This command is explained in section 5.4.38 READ UPPER RIGHT below.

5.4.38 READ UPPER RIGHT

Command format	Format
ASCII	U
Binary	8055

Note: Cannot be used with 8 bit parallel interface.

This command transmits the coordinates (X, Y) of the LOWER LEFT and UPPER RIGHT corners of the plotting area to the host machine.

The coordinates (X, Y) are the coordinate values with the OFFSET point as the origin and are not influenced by FACTOR. The coordinate values are output as integral multiples of 0.1 mm.

As to the format of output data, refer to section 5.3.2 Output Data Format.

5.4.39 READ OFFSET

Command format	Format
ASCII	?
Binary	803 F

Note: Cannot be used with 8 bit parallel interface

This command transmits the OFFSET point coordinates (X_0, Y_0) to control. These are related to the HOME position and are not influenced by FACTOR so that the unit of the coordinate value output is 0.1 mm. As to the format of the transmitted data, refer to section 5.3.2 Output Data Format.

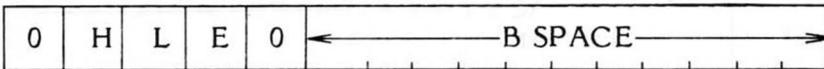
5.4.40 READ STATUS WORD 1

Command format	Format
ASCII	V
Binary	8056

Note: Cannot be used with 8 bit parallel interface.

Monitors the status of the monitor. This command is responded to immediately when it is received. As to the format of (direct command) output data, refer to section 5.3.2 Output Data Format. Internal structure of the status is as follows (internal binary format).

MSB LSB
 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0



When using ASCII format output data, the above status expressed in binary is translated into decimal values and transmitted. In binary format, first the higher rank byte and then the lower rank byte are output.

B SPACE:

Indicates the amount of space currently available in the data buffer memory.

When buffer memory is empty (in decimals)	1664 is shown.
When a unit of data is stored	1663 is shown.
When buffer memory is full	0 is shown.

E: Indicates whether or not an error was present in data received up to the receipt of a READ STATUS WORD command, and whether or not an error came up at the time of data reception.

No error	"0"
Error(s)	"1"

As to the details of errors, refer to section 6.5 Handling of Errors.

L: Indicates whether plotter is in REMOTE or LOCAL modes.

REMOTE mode	"0"
LOCAL mode	"1"

H: Indicates whether or not the CHART HOLD switch on the operation panel is on.

OFF	"0"
ON	"1"

Example: CHART HOLD switch off, LOCAL mode and empty buffer memory is expressed in decimals as follows.

$$2^{13} + 2^{10} + 2^9 + 2^7 = 8192 + 1664 = 9856$$

The errors are only those that have occurred since MASK was reset. When this command is executed, the errors are cleared.

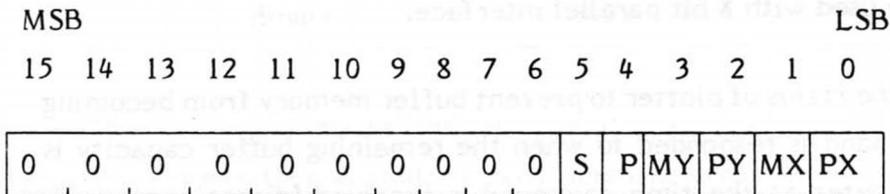
5.4.41 READ STATUS WORD 2

Command format	Format
ASCII	@
Binary	8040

Note: Cannot be used with 8 bit parallel interface.

Monitors the status of plotter. This command is first stored in the buffer memory upon receipt, and the response is transmitted when the command is taken from the buffer memory. As to the output data format, refer to section 5.3.2 Output Data Format.

Internal structure of status (internal binary format)



MY: When a command has been received to go OFF SCALE in the - Y direction: 1

PY: When a command has been received to go OFF SCALE in the + Y direction: 1

MX: When a command has been received to go OFF SCALE in the - X direction: 1

PX: When a command has been received to go OFF SCALE in the + X direction: 1

S: State of FAST/MIDDLE switch
 FAST: 0
 MIDDLE: 1

P: Paper feed mechanism built-in and there is little remaining paper: 1
 Paper feed mechanism not built-in/usual state: 0

Example:

When going OFF SCALE in the + X, and + Y directions at MIDDLE speed the condition is expressed in decimals as follows

$$2^5 + 2^3 + 2^0 = 32 + 4 + 1 = 37$$

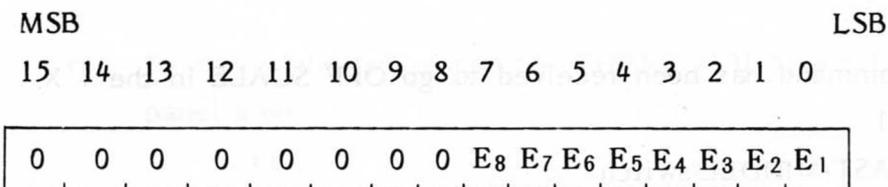
5.4.42 READ STATUS WORD 3

Command format	Format
ASCII	#
Binary	8023

Note: Cannot be used with 8 bit parallel interface.

Monitors the status of plotter to prevent buffer memory from becoming full. This command is responded to when the remaining buffer capacity is more than 256 bytes at the time command is received (direct command). When the same capacity is less than 256, the command is responded to when it gets to 256 bytes or more. As to the format of output data, refer to section 5.3.2 Output Data Format.

Error in input data is indicated as follows (internal binary format)



- | | |
|-----------------------------------|-----------------------------------|
| E ₁ : Command | E ₅ : I/O error |
| E ₂ : Terminator error | E ₆ : Off scale |
| E ₃ : Delimiter error | E ₇ : Chart hold error |
| E ₄ : Parameter error | E ₈ : Paper end |

This command indicates whether or not an error was present in data received up to the present:

- No error: 0
 Error(s): 1

(Refer to section 6.5 Handling of Errors for details.)

When ASCII format output data, 0 - 8 are output in single bytes and the terminator is output at the end. The status is indicated in steps as 0, 1, 2, 4, 8, in which the priority is given in the order of E₁ - E₄. So, if E₁ and E₄ errors are both present, only E₁ will be indicated.

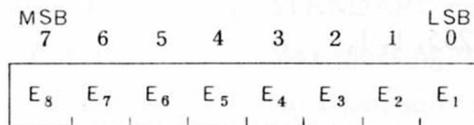
5-4-43 ERROR MASK

Command format	Format
ASCII	" m, n, p,
Binary	8022 m n p

This command masks the error status of the plotter. The error indications are either erased, or only specific errors are indicated, when this command is executed. It also masks the service request of the GP-IB interface or the parallel polling factors. This command is temporarily stored in the buffer memory upon receipt and data processing continues after its execution. Parameters m, n and p are specified as follows:

m: Error mask m = 0 - 255 (initial setting = 1)

When each error bit is 0, masking is carried out and indication of that error is omitted. When a bit becomes 1, the corresponding error is indicated as it occurs. The error mask influences the indications on the control panel and the error statuses of READ STATUS WORD 1, 3. The significance of the error mask bits is as follows. The initial setting is m = 17 so that only the command and I/O errors are indicated.



- | | |
|-----------------------------------|-----------------------------------|
| E ₁ : Command error | E ₅ : I/O error |
| E ₂ : Terminator error | E ₆ : Off-scale |
| E ₃ : Delimiter error | E ₇ : Chart hold error |
| E ₄ : Parameter error | E ₈ : Paper end |

(For details of the errors, refer to section 6-5 "Handling of errors".)

n: Service request mask n = 0 - 15 (initial setting = 0)

Effective only with the GP-IB interface. By setting each bit to 1, service requests are made when the corresponding request factors occur. The significance of the service request mask bits is as follows. When using the RS-232-C or 8-bit parallel interfaces, zeros must be specified as dummies.

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

- S₁: Output request (when data is being output from plotter)
- S₂: Error (when an error occurs)
- S₃: Buffer empty (when the unused capacity of the buffer is 1536 byte or more)
- S₄: Buffer full (when the unused capacity of the buffer is 128 byte or less)

p: Parallel polling mask p = 0 - 15 (initial setting = 0)

Effective with the GP-IB interface only. By setting each bit to 1, a response is given corresponding to each mask bit when parallel polling is designated. (Response bits depend on PPC, PPE.) The significance of the parallel polling bits are the same as those of the service request mask. When using the RS-232-C or 8 bit parallel interfaces, it is necessary to specify zeros as dummies.

(Example) "255, 1, 1,

The error mask is cancelled and all errors are indicated. For the service request and parallel polling, responses are given when data is output.

6. REMARKS ON THE COMMAND FUNCTIONS

6.1 Initial Status

The initial setting of each command as follows.

Command	Parameter	Remarks
LINE TYPE	$P = 0$	Solid line
LINE SCALE	$\ell = 100$	10 mm
WRITE LOWER LEFT	$x = 0$ $y = 0$	HOME position
WRITE UPPER RIGHT	$x = 3810$ $y_1 = 2540$ $y_2 = 2300$	y_2 for 2 pen model otherwise y_1
OFFSET	$x = 0$ $y = 0$	HOME position
FACTOR	$p = 1$ $q = 1$ $r = 1$	Magnification = 1
ALPHA SCALE	$n = 30$	Height of character 3 mm
ALPHA SPACE	$\ell = 30$	Character spacing 3 mm
ALPHA ROTATE	$\theta = 0$	No rotation
ALPHA ITALIC	$p = 0$	No slope
FONT	$n = 0$	STANDARD code
SPEED	$\ell = 10$	Max plotting speed
NEW PEN	$n = 1$	No 1 pen selected
TERM	$t_1 = t_2 =$ (ETX)	

Table 6-1 Initial settings

6.2 The Influence of Commands

Plotting commands influenced by following commands are shown below.

Commands influenced	Commands with influence
PRINT KANA (GREEK) MARK USER'S PATTERN	ALPHA SCALE ALPHA SPACE ALPHA ITALIC ALPHA ROTATE ALPHA RESET
DRAW RELATIVE DRAW CURVE RELATIVE CURVE CIRCLE RELATIVE CIRCLE	LINE TYPE LINE SCALE
All plotting commands except OFFSET, CHART FEED, WRITE LOWER LEFT, WRITE LOWER RIGHT	FACTOR

Table 6-2 Influence of commands

6.3 Order of Carrying Out Commands

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

6.4 Plotting Area and OFF SCALE Controls

The plotting area is the area set by WRITE LOWER LEFT and WRITE UPPER RIGHT. When a program instructs plotting outside the area, SCALE lamp lights and drawing outside the area is omitted. Drawing outside the physically valid plotting area is avoided as well. These are the OFF SCALE controls.

If a drawing command as in Fig. 6-1 is given to draw line a along $P1 \rightarrow P2 \rightarrow P3 \rightarrow P4$, the actual movement of pen is:

$P1 \rightarrow A$ (pen down)

$A \rightarrow B$ (pen up)

$B \rightarrow P4$ (pen down)

The line is drawn only between $P1 \rightarrow A$ and $B \rightarrow P4$. So deviation of plotting is not caused by OFF SCALE.

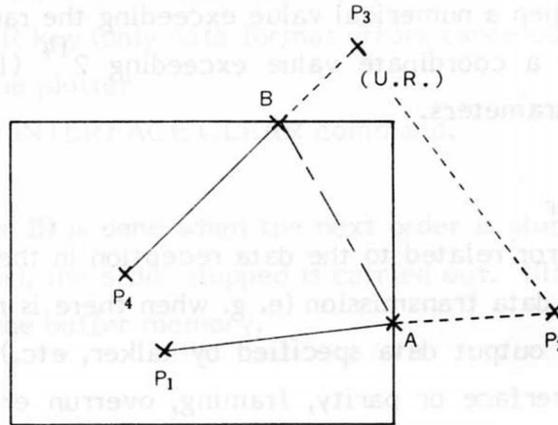


Fig. 6-1 OFF SCALE control

6.5 Handling of Errors

These are 2 main cause of errors:

a) Data error:

Errors in the format, etc. of the input data. These occur from not following the Input Data Format (section 5.3.1). For example; if the X coordinate is given but not the Y coordinate, a terminator is omitted although one is necessary, etc. When these errors come up the ERROR bit becomes "1", the OFF SCALE and PROMPT lamps on the control panel flash alternately and commands are temporary stopped, except for direct commands. These errors are further divided into the following 4 types:

- o Command error
When a code between $(60)_{16}$ and $(7E)_{16}$ has been handled as a command character.
- o Terminator error
When a terminator wasn't attached when one was necessary.
- o Delimiter error
When a delimiter was omitted or when an undefined character was handled as a delimiter.
- o Parameter overflow
When a numerical value exceeding the range of $-32767 - +32767$ or a coordinate value exceeding 2^{14} (16384) are handled as parameters.

b) I/O error

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

c) OFFSCALE:

When data is received commanding drawing outside the effective plotting area, the OFF SCALE lamp on the control panel comes on and the off-scale bit of the error status becomes 1.

When data is received instructing the pen to return to the effective plotting area, the OFF SCALE lamp goes off and the off-scale bit of the error status becomes 0.

d) CHART HOLD error:

The content of this error message depends on whether or not the plotter has a recording paper feed mechanism.

In a plotter with a recording paper feed mechanism, the chart hold error bit of the error status becomes 1 when the CHART HOLD switch on the control panel is on.

In a plotter without a recording paper feed mechanism, the chart hold error bit of the status becomes 0 when the CHART HOLD switch on the control panel is off.

e) Paper end:

Effective only when the plotter has a recording paper feed mechanism. The paper end bit of the error status becomes 1 when the remaining roll paper is less than approximately 1 meter.

f) Error clearance

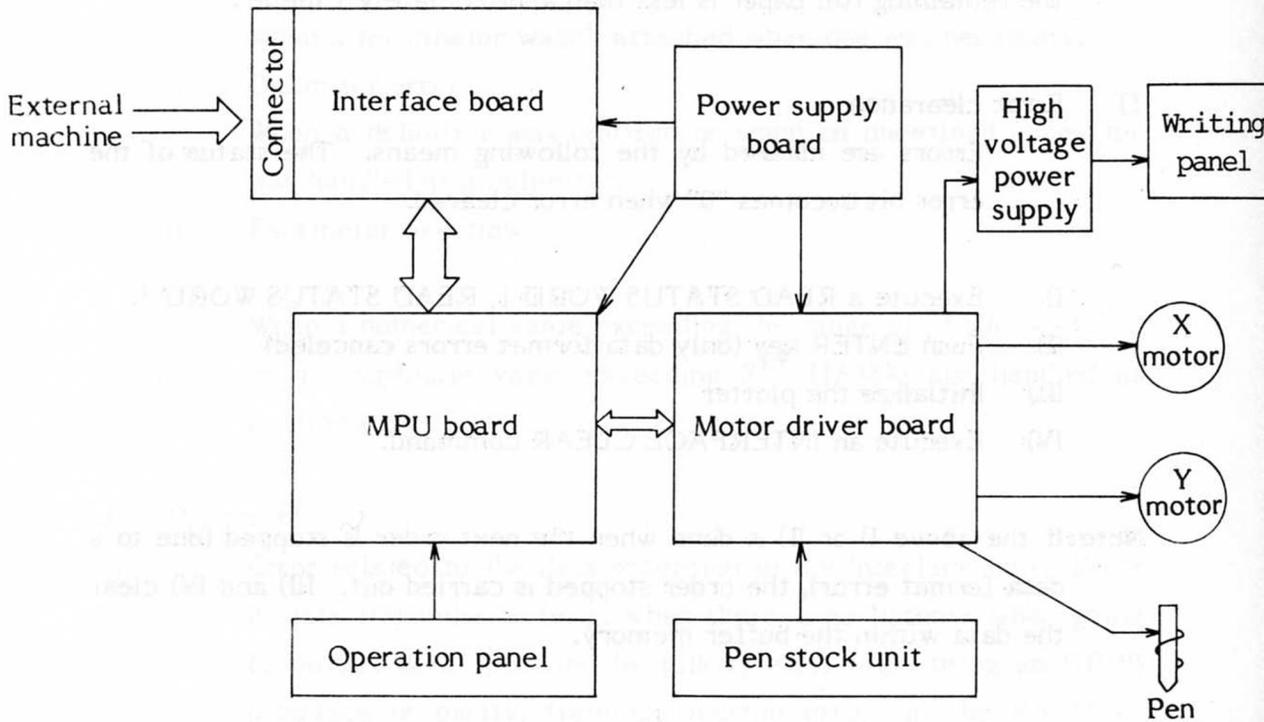
Errors are cleared by the following means. The status of the error bit becomes "0" when error cleared.

- I) Execute a READ STATUS WORD 1, READ STATUS WORD 3.
- II) Push ENTER key (only data format errors canceled)
- III) Initialize the plotter
- IV) Execute an INTERFACE CLEAR command.

Note: If the above I) or II) is done when the next order is stopped (due to a data format error), the order stopped is carried out. III) and IV) clear the data within the buffer memory.

7. OPERATION PRINCIPLES

7.1 Configuration



7.2 Basic Functions and Operations

Data transmitted from the external machine enters the MPU board via the interface board by means of the MPU's software. The commands are decoded here and are output to the respective boards as signals. The operations of the operation panel are also handled through the MPU so that the pen position is controlled by the MPU and does not go out of the plotting area.

7.2.1 Functions of Each Part

o Interface board:

The basic function of the interface is data relay. Processing of data from outside is done by the MPU of the plotter. However, some commands directly related to the interface are handled by the interface.

There are 3 kinds of interface.

1) RS-232C board

The data input from external equipment as serial data are converted in the interface to 8 bit parallel data and are output to the MPU board. Mounted on the board are a Z80 (8 bit microcomputer), with a ROM, RAM, digital switches (to specify condition of interface), etc. to control the input and output of data.

2) GP-IB board

Uses GP-IB adapter IC for the interchange of data with external equipment and has a Z80, with a ROM, RAM, etc. for data control. Data from outside is handled by internal functions and is output to the MPU board.

3) 8 bit parallel board

8 bit parallel data is received by means of data strobe signals and is output to the MPU board. This board only doesn't output data to external equipment.

o MPU board

Consists of 8 bit microcomputer Z80, with a RAM, ROM, I/O board, and a few LSI's and IC's. Here, all kinds of functions such as command read out, character generation, generation of motor drive control signals, etc. are handled by means of software.

o Motor driver board

Drives the pulse motors by switching regulator method according to signals generated in the MPU board. This board heats up slightly since power transistors (for the motor drive), resistors, diodes, etc. are mounted on it.

o Writing panel

By applying a high voltage to the comb electrodes, the recording paper is adsorbed by static electricity providing an easy setting of the paper.

o Pen stocks

10 pens can be stocked. Each stock has a sensor to notify whether or not pen is stocked.

8. DAILY MAINTENANCE AND ATTENTION

8.1 Cleaning of Writing Panel

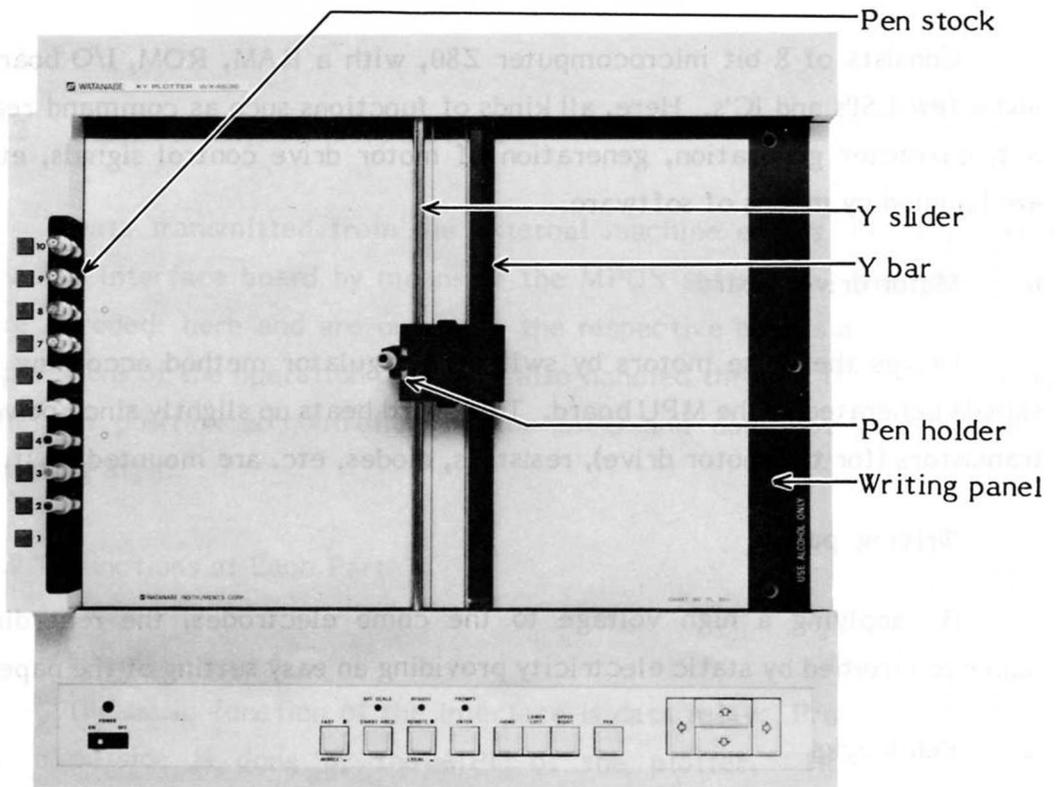
Cleaning the panel surface is necessary as adsorption is deteriorated by stains, etc. Dust should be wiped off by a wet cloth such as gauze. Oil stains, etc. can be wiped off by a cloth soaked in a neutral detergent or alcohol diluted with water 1:1000.

Note:

1. Do not use thinners
2. Wet panel surface may also affect adsorption. For this reason dry the panel (with a dryer, etc.) thoroughly after cleaning.

8.2 Cleaning of the Sliding Units

Wipe the Y slider and Y bar with a cloth dampened with alcohol.



8.3 Pen Stocks and Holder Units

Strong magnets are incorporated in the pen stocks and holder. Do not allow magnetic objects other than the pens near them.

Beware of iron filings which are difficult to remove once attached.

APPENDIX

1. Command Functions

Remarks	Command	Data format	Function	
Straight line movements	DRAW	$D x_1, y_1, x_2, y_2 \dots \dots x_n, y_n (t)$	Draws straight line segments connecting the points $(x_1, y_1), (x_2, y_2) \dots \dots (x_n, y_n)$	LINE TYPE and LINE SCALE settings are effective. For specification of (t) refer to TERM command.
	RELATIVE DRAW	$E \Delta x_1, \Delta y_1, \Delta x_2, \Delta y_2 \dots \dots \Delta x_n, \Delta y_n (t)$	Draws straight line segments with the relative displacements $(\Delta x_1, \Delta y_1), (\Delta x_2, \Delta y_2) \dots \dots (\Delta x_n, \Delta y_n)$	
	MOVE	$Mx, y,$	Moves the pen to coordinates (x, y) with the pen raised.	
	RELATIVE MOVE	$O \Delta x, \Delta y,$	Moves with the pen raised from the current position through a distance of $(\Delta x, \Delta y)$	
Characters and symbols	PRINT	$P c_1 c_2 \dots \dots c_n (t)$	Plots the numbers represented by the codes $c_1, c_2 \dots \dots c_n$ (Refer to the appendix codes)	ALPHA RESET, ALPHA SCALE, ALPHA SPACE, ALPHA ROTATE, and ALPHA ITALIC are effective.
	KANA (GREEK)	$K c_1 c_2 \dots \dots c_n (t)$	Plots the Katakana characters and Greek characters specified by codes $c_1, c_2 \dots \dots c_n$. (Refer to the appendix codes)	
	MARK	$N n,$	Draws the special symbol specified by n centered on the current pen position.	
	USER'S PATTERN	$(n_1, n_2 \dots \dots (t)$	Plots the pattern specified by the user. (optional)	

Remarks	Command	Data format	Function	
Curves	CIRCLE	W $x_0, y_0, r_1, r_2, \theta_1, \theta_2,$	Draws circles, circular arcs and spirals. (x_0, y_0): coordinates of center. (r_0, r_2): initial and final radii. (θ_1, θ_2): initial and final angles.	
	RELATIVE CIRCLE	] $r_1, r_2, \theta_1, \theta_2$	Draws circles, circular arcs and spirals. (r_1, r_2): initial and final radii. (θ_1, θ_2): initial and final angles. The starting point is the current pen position.	
	CURVE	Y a, $x_1, y_1, x_2, y_2 \dots$ $\dots x_n, y_n$ (t)	Draws a smooth curve through the points with coordinates (x_1, y_1), (x_2, y_2) (x_n, y_n) a = 0: open curve a = 1: closed curve	For specification of (t) refer to TERM command.
	RELATIVE CURVE	← a, $\Delta x_1, \Delta y_1, \Delta x_2, \Delta y_2 \dots \Delta x_n, \Delta y_n$ (t)	Draws a smooth curve through the points whose coordinates are given by successive relative displacements, starting from the current pen position. ($\Delta x_1, \Delta y_1$): relative coordinates of the starting point of the curve from the current pen position. ($\Delta x_2, \Delta y_2$) ... ($\Delta x_n, \Delta y_n$) relative direct displacements of successive points. a = 0: open curve a = 1: closed curve	The "←" character is represented by "—" in the JIS codes.

Remarks	Command	Data format	Function	
Line type specification	LINE TYPE	L p,	Specifies the line type. p = 0: solid line p = 1 - 4: dotted and broken lines p = 5 - 6: dot-dash lines p = 7 - 8: double dot-dash lines	Initial setting is p = 0
	LINE SCALE	B ℓ	The repetition length for broken lines is specified by ℓ . (has no effect on solid lines.)	Initial setting is $\ell = 100$
Character and symbol specifications	FONT	\$ n,	Selects type of characters to be drawn from PRINT and KANA commands according to character code table. (Refer to the appendix codes.)	Initial setting is n = 0
	ALPHA SCALE	S n,	n specifies the height of characters and symbols.	Initial setting is n = 30
	ALPHA SPACE	Q n,	n specifies the spacing from one character or symbol to the next.	Initial setting is n = 30
	ALPHA ROTATE	R θ ,	θ specifies the rotation of characters and symbols.	Initial setting is $\theta = 0$
	ALPHA ITALIC	I p,	p specifies the slope of characters and symbols. p = 256.tan θ (θ is the inclination from the Y axis)	Initial setting is p = 0
	ALPHA RESET	A	Returns character and symbol settings to	

Remarks	Command	Data format	Function	
Control functions	CLEAR	:	Carries out plotter initialization. All control settings are returned to their initial values.	
	HOME	H	Moves with the pen raised to the HOME position.	
	OFFSET	$\uparrow x, y,$	Sets the origin to the coordinates (x, y).	Initial setting is the same as the HOME POSITION " \uparrow " is " \wedge " in JIS codes.
	CHART FEED	$Fl,$	Effective when a chart drive mechanism is provided; feeds the paper by the amount specified by . $l = 0$: feeds one page equivalent (500mm). $l > 0$: feeds the specified length.	
	NEW PEN	$J n,$	Selects pen n (only in Multipen plotters).	Initial setting is $n = 1$
	PROMPT LIGHT	$T n,$	Controls the PROMPT LAMP on the operation panel. $n = 0$: off $n = 1$: on	Initial setting in REMOTE mode is off.
	WRITE LOWER LEFT	$\swarrow x, y,$	Specifies the coordinates of the lower left corner of the plotting area.	Initial setting is $x = y = 0$
	WRITE UPPER RIGHT	$Z x, y,$	Specifies the coordinates of the upper right corner of the plotting area.	Initial setting is the maximum plotting area.

Remarks	Command	Data format	Function	
Control functions	SPEED	$!l$	When pen is down in plotter, sets the pen speed in 10 stages. ($l = 1, 2, \dots, 10$)	Initial setting: $l = 10$
	FACTOR	&, p, q, r,	Sets the plotting magnification. p/r = magnification of X axis q/r = magnification of Y axis	Initial setting: p = q = r = 1
Read-out of coordinate values	GIN	G	Transmits the current pen x and y coordinates and pen up/down state to the host machine.	Data is transmitted in the order: x coordinate, y coordinate, pen state.
	CALL GIN	C	Transmits the position and pen state at the time the ENTER key on the operation panel is pressed.	
	READ OFFSET	?	Transmits the coordinates of the origin to the host machine.	
	READ LOWER LEFT	[	Transmits the coordinates of the lower left corner of the plotting area to the host machine.	Data is transmitted in the order: x coordinate then y coordinate.
	READ UPPER RIGHT	U	Transmits the coordinates of the upper right corner of the plotting area to the host machine.	
Interface control	INTERFACE CLEAR	;	Initializes interface control. Any data remaining in the buffer will be lost.	
	READ STATUS WORD 1	V	Transmits the plotter status word 1 to the host machine. Transmission takes place immediately this command is received.	
	ERROR MASK	"m.m.p	Mask of the error-bit of the READ	

Remarks	Command	Data format	Function	
✓	READ STATUS WORD 2	@	Transmits the plotter status word 2 to the host machine.	
✓	READ STATUS WORD 3	#	Transmits the plotter status word 3 to the host machine. Transmission takes place when the remaining buffer capacity is not less than 256 bytes when this command is received.	
	TERM	= t_1, t_2	Specifies the data terminator characters t_1 and t_2 . t_1 and t_2 may be the same.	Initial setting is $t_1 = t_2 = (\text{ETX})$
Graph plotting	AXIS	X p, q, r,	Draws a coordinate axis parallel to either the x or y axis. p = 0 (Y axis) q = unit length, p = 1 (X axis) r = number of repetitions p = 2 (Y axis) q = overall length, p = 3 (X axis) r = number of divisions	
	HATCHING	% n, x, y, d, θ ,	Draws rectangles parallel to the x and y axes and hatching. n = 1: rectangles only n = 2: hatching only n = 3: rectangles and internal hatching	

2. Code Table (FONT CODE)

Appendix Code Table 2-1 Font \$ 0, (Standard)

					B ₈ = 0 (In case of 8bit code)								B ₈ = 1 (In case of 8bits code)									
					SI								SO									
B ₇	B ₆	B ₅	B ₄	B ₃	B ₂	B ₁	0	1	2	3	4	5	6	7	0(8)	1(9)	2(A)	3(B)	4(C)	5(D)	6(E)	7(F)
0	0	0	0	0	0	0																
0	0	0	0	1	1	1																
0	0	0	1	1	0	0																
0	0	1	0	1	0	1																
0	0	1	1	1	1	1																
0	1	0	0	0	0	0																
0	1	0	0	1	1	1																
0	1	0	1	1	0	0																
0	1	1	0	0	0	0																
0	1	1	0	1	1	1																
0	1	1	1	1	0	0																
1	0	0	0	0	0	0																
1	0	0	0	1	1	1																
1	0	0	1	0	0	0																
1	0	0	1	0	1	1																
1	0	1	0	0	0	0																
1	0	1	0	1	1	1																
1	0	1	1	0	0	0																
1	0	1	1	0	1	1																
1	1	0	0	0	0	0																
1	1	0	0	1	1	1																
1	1	0	1	0	0	0																
1	1	0	1	0	1	1																
1	1	1	0	0	0	0																
1	1	1	0	1	1	1																
1	1	1	1	0	0	0																
1	1	1	1	0	1	1																
1	1	1	1	1	0	0																
1	1	1	1	1	1	1																

Note : SP is space code
: Not used undefined code

The code tables of FONT \$ 11, 12 19 are not being published in this appendix. However they are the same as FONT \$ 1 - 9 of the "B₈ = 0" code table combined with FONT \$ 10 of the "B₈ = 1" code table.

Appendix Code Table 2-2 FONT \$ 0, (ISO)

					B ₈ = 0 (In case of 8bits code)								B ₈ = 1 (In case of 8bits code)									
					SI								SO									
B ₇	B ₆	B ₅	B ₄	B ₃	B ₂	B ₁	0	1	2	3	4	5	6	7	0(8)	1(9)	2(A)	3(B)	4(C)	5(D)	6(E)	7(F)
0	0	0	0	0	0	0																
0	0	0	0	1	1	1																
0	0	0	1	1	0	0																
0	0	1	0	1	0	1																
0	0	1	1	1	1	1																
0	1	0	0	0	0	0																
0	1	0	0	1	1	1																
0	1	0	1	1	0	0																
0	1	1	0	0	0	0																
0	1	1	0	1	1	1																
0	1	1	1	0	0	0																
0	1	1	1	0	1	1																
0	1	1	1	1	0	0																
0	1	1	1	1	1	1																
1	0	0	0	0	0	0																
1	0	0	0	1	1	1																
1	0	0	1	0	0	0																
1	0	0	1	0	1	1																
1	0	1	0	0	0	0																
1	0	1	0	1	1	1																
1	0	1	1	0	0	0																
1	0	1	1	0	1	1																
1	0	1	1	1	0	0																
1	0	1	1	1	1	1																
1	1	0	0	0	0	0																
1	1	0	0	1	1	1																
1	1	0	1	0	0	0																
1	1	0	1	0	1	1																
1	1	1	0	0	0	0																
1	1	1	0	1	1	1																
1	1	1	1	0	0	0																
1	1	1	1	0	1	1																
1	1	1	1	1	0	0																
1	1	1	1	1	1	1																

Note : SP is space code
: Not used undefined code

Appendix Code Table 2-3 FONT \$ 2, (Japan)

				B ₈ = 0 (In case of 8bits code)								B ₈ = 1 (In case of 8bits code)									
				S1								S0									
				B7	0	0	0	0	1	1	1	1	B7	0	0	0	0	1	1	1	1
				B6	0	0	1	1	0	0	1	1	B6	0	0	1	1	0	0	1	1
				B5	0	1	0	1	0	1	0	1	B5	0	1	0	1	0	1	0	1
B ₄	B ₃	B ₂	B ₁	0	1	2	3	4	5	6	7	0(8)	1(9)	2(A)	3(B)	4(C)	5(D)	6(E)	7(F)		
0	0	0	0	0		SP	SP	0	@	P	'	p		SP	SP	-	タ	ミ	SP	π	
0	0	0	1	1		·	!	1	A	Q	a	q		Γ	ο	ア	チ	ム	α	ρ	
0	0	1	0	2		◇	#	2	B	R	b	r		Δ	「	イ	ツ	メ	β	σ	
0	0	1	1	3	ETX	□	#	3	C	S	c	s	ETX	Z	」	ウ	テ	モ	γ	τ	
0	1	0	0	4		△	\$	4	D	T	d	t		(H)	·	エ	ト	ヤ	δ	υ	
0	1	0	1	5		⊙	%	5	E	U	e	u		Λ	·	オ	ナ	ユ	ε	φ	
0	1	1	0	6		⊗	&	6	F	V	f	v		(H)	ヲ	カ	ニ	ヨ	ζ	χ	
0	1	1	1	7		⊗	'	7	G	W	g	w		O	ア	キ	ヌ	ラ	η	φ	
1	0	0	0	8	BS	+	(	8	H	X	h	x	BS	Π	イ	ク	ネ	リ	θ	ω
1	0	0	1	9		Y	)	9	I	Y	i	y		Σ	ウ	ケ	ノ	ル	ι	≡
1	0	1	0	A	LF	⊕	*	:	J	Z	j	z	LF	Υ	エ	コ	ハ	レ	κ	≧	
1	0	1	1	B		⊗	+	;	K	(	k	{		Φ	*	サ	ヒ	ロ	λ	±
1	1	0	0	C		⊗	,	<	L	¥	l	|		Ψ	チ	シ	フ	ワ	μ	⊙	
1	1	0	1	D	CR	⊗	-	=	M	)	m	}	CR	Ω	ユ	ス	ヘ	ン	ν	℃
1	1	1	0	E	SO	*	·	>	N	^	n	~	SO	SP	ヨ	セ	ホ	ミ	ξ	∞	
1	1	1	1	F	SI	☆	/	?	O	-	o		SI	SP	ッ	ソ	マ	ο	ο	ο	

Note : SP is space code
: Not used undefined code

Appendix Code Table 2-4 FONT \$ 3, (U. S. A.)

				B ₈ = 0 (In case of 8bits code)								B ₈ = 1 (In case of 8bits code)									
				S1								S0									
				B7	0	0	0	0	1	1	1	1	B7	0	0	0	0	1	1	1	1
				B6	0	0	1	1	0	0	1	1	B6	0	0	1	1	0	0	1	1
				B5	0	1	0	1	0	1	0	1	B5	0	1	0	1	0	1	0	1
B ₄	B ₃	B ₂	B ₁	0	1	2	3	4	5	6	7	0(8)	1(9)	2(A)	3(B)	4(C)	5(D)	6(E)	7(F)		
0	0	0	0	0		SP	SP	0	@	P	'	p		SP	SP	-	タ	ミ	SP	π	
0	0	0	1	1		·	!	1	A	Q	a	q		Γ	ο	ア	チ	ム	α	ρ	
0	0	1	0	2		◇	#	2	B	R	b	r		Δ	「	イ	ツ	メ	β	σ	
0	0	1	1	3	ETX	□	#	3	C	S	c	s	ETX	Z	」	ウ	テ	モ	γ	τ	
0	1	0	0	4		△	\$	4	D	T	d	t		(H)	·	エ	ト	ヤ	δ	υ	
0	1	0	1	5		⊙	%	5	E	U	e	u		Λ	·	オ	ナ	ユ	ε	φ	
0	1	1	0	6		⊗	&	6	F	V	f	v		(H)	ヲ	カ	ニ	ヨ	ζ	χ	
0	1	1	1	7		⊗	'	7	G	W	g	w		O	ア	キ	ヌ	ラ	η	φ	
1	0	0	0	8	BS	+	(	8	H	X	h	x	BS	Π	イ	ク	ネ	リ	θ	ω
1	0	0	1	9		Y	)	9	I	Y	i	y		Σ	ウ	ケ	ノ	ル	ι	≡
1	0	1	0	A	LF	⊕	*	:	J	Z	j	z	LF	Υ	エ	コ	ハ	レ	κ	≧	
1	0	1	1	B		⊗	+	;	K	(	k	{		Φ	*	サ	ヒ	ロ	λ	±
1	1	0	0	C		⊗	,	<	L	\	l	|		Ψ	チ	シ	フ	ワ	μ	⊙	
1	1	0	1	D	CR	⊗	-	=	M	)	m	}	CR	Ω	ユ	ス	ヘ	ン	ν	℃
1	1	1	0	E	SO	*	·	>	N	^	n	~	SO	SP	ヨ	セ	ホ	ミ	ξ	∞	
1	1	1	1	F	SI	☆	/	?	O	-	o		SI	SP	ッ	ソ	マ	ο	ο	ο	

Note : SP is space code
: Not used undefined code

Appendix Code Table 2-5 FONT \$ 4, (England)

				B ₈ = 0 (In case of 8bits code)								B ₈ = 1 (In case of 8bits code)									
				SI								SO									
				B7	0	0	0	0	1	1	1	1	B7	0	0	0	0	1	1	1	1
				B6	0	0	1	1	0	0	1	1	B6	0	0	1	1	0	0	1	1
				B5	0	1	0	1	0	1	0	1	B5	0	1	0	1	0	1	0	1
B ₄	B ₃	B ₂	B ₁	0	1	2	3	4	5	6	7	0(8)	1(9)	2(A)	3(B)	4(C)	5(D)	6(E)	7(F)		
0	0	0	0	0	SP	SP	0	@	P	'	p	SP	SP	-	タ	ミ	SP	π			
0	0	0	1	1	•	!	1	A	Q	a	q	Γ	ο	ア	チ	ム	α	ρ			
0	0	1	0	2	◇	#	2	B	R	b	r	Δ	「	イ	ツ	メ	β	σ			
0	0	1	1	3	ETX	□	£	3	C	S	c	s	ETX	Z	」	ウ	テ	モ	τ		
0	1	0	0	4	△	\$	4	D	T	d	t	(H)	,	エ	ト	ヤ	θ	υ			
0	1	0	1	5	○	¢	5	E	U	e	u	Λ	•	オ	ナ	ユ	ε	φ			
0	1	1	0	6	⊗	&	6	F	V	f	v	(H)	ヲ	カ	ニ	ヨ	ζ	χ			
0	1	1	1	7	⊗	/	7	G	W	g	w	O	フ	キ	ス	ラ	η	φ			
1	0	0	0	8	BS	+	(8	H	X	h	x	BS	Π	イ	ク	ネ	リ	θ		
1	0	0	1	9	Y	)	9	I	Y	i	y	Σ	ク	ケ	ノ	ル	ι	ω		
1	0	1	0	A	LF	⊕	*	:	J	Z	j	z	LF	Υ	エ	コ	ハ	レ	κ		
1	0	1	1	B	⊗	+	;	K	(	k	{	Φ	•	サ	ヒ	ロ	λ	±		
1	1	0	0	C	⊗	,	<	L	\	l	|	Ψ	+	シ	フ	ワ	μ	ε			
1	1	0	1	D	CR	⊗	-	=	M	\	m	CR	Ω	ユ	ス	ヘ	ン	ν			
1	1	1	0	E	SO	*	•	>	N	↑	n	SO	SP	•	セ	ホ	ミ	ξ			
1	1	1	1	F	SI	☆	/	?	O	-	o	SI	SP	ッ	ソ	マ	ο	ο			

Note : SP is space code
: Not used undefined code

Appendix Code Table 2-6 FONT \$ 5, (West Germany)

				B ₈ = 0 (In case of 8bits code)								B ₈ = 1 (In case of 8bits code)									
				SI								SO									
				B7	0	0	0	0	1	1	1	1	B7	0	0	0	0	1	1	1	1
				B6	0	0	1	1	0	0	1	1	B6	0	0	1	1	0	0	1	1
				B5	0	1	0	1	0	1	0	1	B5	0	1	0	1	0	1	0	1
B ₄	B ₃	B ₂	B ₁	0	1	2	3	4	5	6	7	0(8)	1(9)	2(A)	3(B)	4(C)	5(D)	6(E)	7(F)		
0	0	0	0	0	SP	SP	0	§	P	'	p	SP	SP	-	タ	ミ	SP	π			
0	0	0	1	1	•	!	1	A	Q	a	q	Γ	ο	ア	チ	ム	α	ρ			
0	0	1	0	2	◇	#	2	B	R	b	r	Δ	「	イ	ツ	メ	β	σ			
0	0	1	1	3	ETX	□	£	3	C	S	c	s	ETX	Z	」	ウ	テ	モ	τ		
0	1	0	0	4	△	\$	4	D	T	d	t	(H)	,	エ	ト	ヤ	θ	υ			
0	1	0	1	5	○	¢	5	E	U	e	u	Λ	•	オ	ナ	ユ	ε	φ			
0	1	1	0	6	⊗	&	6	F	V	f	v	(H)	ヲ	カ	ニ	ヨ	ζ	χ			
0	1	1	1	7	⊗	/	7	G	W	g	w	O	フ	キ	ス	ラ	η	φ			
1	0	0	0	8	BS	+	(8	H	X	h	x	BS	Π	イ	ク	ネ	リ	θ		
1	0	0	1	9	Y	)	9	I	Y	i	y	Σ	ク	ケ	ノ	ル	ι	ω		
1	0	1	0	A	LF	⊕	*	:	J	Z	j	z	LF	Υ	エ	コ	ハ	レ	κ		
1	0	1	1	B	⊗	+	;	K	Ä	k	ä	Φ	•	サ	ヒ	ロ	λ	±			
1	1	0	0	C	⊗	,	<	L	Ö	l	ö	Ψ	+	シ	フ	ワ	μ	ε			
1	1	0	1	D	CR	⊗	-	=	M	Ü	m	CR	Ω	ユ	ス	ヘ	ン	ν			
1	1	1	0	E	SO	*	•	>	N	^	n	SO	SP	•	セ	ホ	ミ	ξ			
1	1	1	1	F	SI	☆	/	?	O	-	o	SI	SP	ッ	ソ	マ	ο	ο			

Note : SP is space code
: Not used undefined code

Appendix Code Table 2-7 FONT \$ 6, (France)

				B ₈ = 0 (In case of 8bits code)								B ₈ = 1 (In case of 8bits code)									
				S1								S0									
				B7	0	0	0	0	1	1	1	1	B7	0	0	0	0	1	1	1	1
				B6	0	0	1	1	0	0	1	1	B6	0	0	1	1	0	0	1	1
				B5	0	1	0	1	0	1	0	1	B5	0	1	0	1	0	1	0	1
B ₄	B ₃	B ₂	B ₁	0	1	2	3	4	5	6	7	0(8)	1(9)	2(A)	3(B)	4(C)	5(D)	6(E)	7(F)		
0	0	0	0	0		SP	SP	0	ā	P	'	p		SP	SP	—	タ	ミ	SP	π	
0	0	0	1	1		·	!	1	A	Q	a	q		Γ	ο	ア	チ	Δ	α	ρ	
0	0	1	0	2		◇	#	2	B	R	b	r		Δ	「	イ	ツ	メ	β	σ	
0	0	1	1	3	ETX	□	£	3	C	S	c	s	ETX	Z	」	ウ	テ	モ	γ	τ	
0	1	0	0	4		△	\$	4	D	T	d	t		(H)	・	エ	ト	ヤ	δ	υ	
0	1	0	1	5		⊙	¢	5	E	U	e	u		Λ	・	オ	ナ	ユ	ε	φ	
0	1	1	0	6		⊗	&	6	F	V	f	v		(H)	ヲ	カ	ニ	ヨ	ζ	χ	
0	1	1	1	7		⊗	'	7	G	W	g	w		O	ア	キ	ヌ	ラ	η	ψ	
1	0	0	0	8	BS	+	(	8	H	X	h	x	BS	Π	イ	ク	ネ	リ	θ	ω
1	0	0	1	9		Y	)	9	I	Y	i	y		Σ	ウ	ケ	ノ	ル	ι	≤
1	0	1	0	A	LF	⊕	*	:	J	Z	j	z	LF	Υ	エ	コ	ハ	レ	κ	≥	
1	0	1	1	B		⊗	+	;	K	o	k	é		Φ	・	サ	ヒ	ロ	λ	±	
1	1	0	0	C		⊗	,	<	L	ç	l	ü		Ψ	・	シ	フ	ワ	μ	℄	
1	1	0	1	D	CR	⊗	-	=	M	š	m	è	CR	Ω	ユ	ス	ヘ	ン	ν	℃	
1	1	1	0	E	SO	*	.	>	N	^	n	..	SO	SP	・	セ	ホ	ミ	ξ	∞	
1	1	1	1	F	SI	☆	/	?	O	—	o		SI	SP	ッ	ッ	マ	o	o		

Note : SP is space code
: Not used undefined code

Appendix Code Table 2-8 FONT \$ 7, (Sweden)

				B ₈ = 0 (In case of 8bits code)								B ₈ = 1 (In case of 8bits code)									
				S1								S0									
				B ₇	0	0	0	0	1	1	1	1	B ₇	0	0	0	0	1	1	1	1
				B ₆	0	0	1	1	0	0	1	1	B ₆	0	0	1	1	0	0	1	1
				B ₅	0	1	0	1	0	1	0	1	B ₅	0	1	0	1	0	1	0	1
B ₄	B ₃	B ₂	B ₁	0	1	2	3	4	5	6	7	0(8)	1(9)	2(A)	3(B)	4(C)	5(D)	6(E)	7(F)		
0	0	0	0	0		SP	SP	0	@	P	'	p		SP	SP	—	タ	ミ	SP	π	
0	0	0	1	1		·	!	1	A	Q	a	q		Γ	ο	ア	チ	Δ	α	ρ	
0	0	1	0	2		◇	#	2	B	R	b	r		Δ	「	イ	ツ	メ	β	σ	
0	0	1	1	3	ETX	□	£	3	C	S	c	s	ETX	Z	」	ウ	テ	モ	γ	τ	
0	1	0	0	4		△	\$	4	D	T	d	t		(H)	・	エ	ト	ヤ	δ	υ	
0	1	0	1	5		⊙	¢	5	E	U	e	u		Λ	・	オ	ナ	ユ	ε	φ	
0	1	1	0	6		⊗	&	6	F	V	f	v		(H)	ヲ	カ	ニ	ヨ	ζ	χ	
0	1	1	1	7		⊗	'	7	G	W	g	w		O	ア	キ	ヌ	ラ	η	ψ	
1	0	0	0	8	BS	+	(	8	H	X	h	x	BS	Π	イ	ク	ネ	リ	θ	ω
1	0	0	1	9		Y	)	9	I	Y	i	y		Σ	ウ	ケ	ノ	ル	ι	≤
1	0	1	0	A	LF	⊕	*	:	J	Z	j	z	LF	Υ	エ	コ	ハ	レ	κ	≥	
1	0	1	1	B		⊗	+	;	K	Ä	k	ä		Φ	・	サ	ヒ	ロ	λ	±	
1	1	0	0	C		⊗	,	<	L	Ö	l	ö		Ψ	・	シ	フ	ワ	μ	℄	
1	1	0	1	D	CR	⊗	-	=	M	Å	m	å	CR	Ω	ユ	ス	ヘ	ン	ν	℃	
1	1	1	0	E	SO	*	.	>	N	^	n	—	SO	SP	・	セ	ホ	ミ	ξ	∞	
1	1	1	1	F	SI	☆	/	?	O	—	o		SI	SP	ッ	ッ	マ	o	o		

Note : SP is space code
: Not used undefined code

Appendix Code Table 2-9 FONT \$ 8, (Denmark)

					B ₈ = 0 (In case of 8bits code)								B ₈ = 1 (In case of 8bits code)									
					S1								S0									
					B7	0	0	0	0	1	1	1	1	B7	0	0	0	0	1	1	1	1
					B6	0	0	1	1	0	0	1	1	B6	0	0	1	1	0	0	1	1
					B5	0	1	0	1	0	1	0	1	B5	0	1	0	1	0	1	0	1
B ₄	B ₃	B ₂	B ₁		0	1	2	3	4	5	6	7	0(8)	1(9)	2(A)	3(B)	4(C)	5(D)	6(E)	7(F)		
0	0	0	0	0		SP	SP	0	@	P	'	p		SP	SP	-	タ	ミ	SP	π		
0	0	0	1	1		·	!	1	A	Q	a	q		Γ	ο	ア	チ	ム	α	ρ		
0	0	1	0	2		◇	#	2	B	R	b	r		Δ	「	イ	ツ	メ	β	σ		
0	0	1	1	3	ETX	□	£	3	C	S	c	s	ETX	Z	」	ウ	テ	モ	γ	τ		
0	1	0	0	4		△	\$	4	D	T	d	t		(H)	·	エ	ト	ヤ	δ	υ		
0	1	0	1	5		⊙	¢	5	E	U	e	u		Λ	·	オ	ナ	ユ	ε	φ		
0	1	1	0	6		⊗	&	6	F	V	f	v		(H)	ヲ	カ	ニ	ヨ	ζ	χ		
0	1	1	1	7		×	/	7	G	W	g	w		O	フ	キ	ス	ラ	η	φ		
1	0	0	0	8	BS	+	(	8	H	X	h	x	BS	Π	イ	ク	ネ	リ	θ	ε	
1	0	0	1	9		Y	)	9	I	Y	i	y		Σ	ク	ケ	ノ	ル	ι	≡	
1	0	1	0	A	LF	⊕	*	:	J	Z	j	z	LF	Υ	エ	コ	ハ	レ	κ	≡		
1	0	1	1	B		⊗	+	:	K	Æ	k	æ		Φ	+	サ	ヒ	ロ	λ	±		
1	1	0	0	C		⊗	,	<	L	Θ	l	θ		Ψ	+	シ	フ	ワ	μ	⊕		
1	1	0	1	D	CR	⊗	-	=	M	À	m	à	CR	Ω	ユ	ス	ヘ	ン	ν	⊕		
1	1	1	0	E	SO	*	·	>	N	^	n	-	SO	SP	ヨ	セ	ホ	ミ	ξ	∞		
1	1	1	1	F	SI	☆	/	?	O	-	o	-	SI	SP	ッ	ソ	マ	ο	ο	ο		

Note : SP is space code
: Not used undefined code

Appendix Code Table 2-10 FONT \$ 9, (Spain)

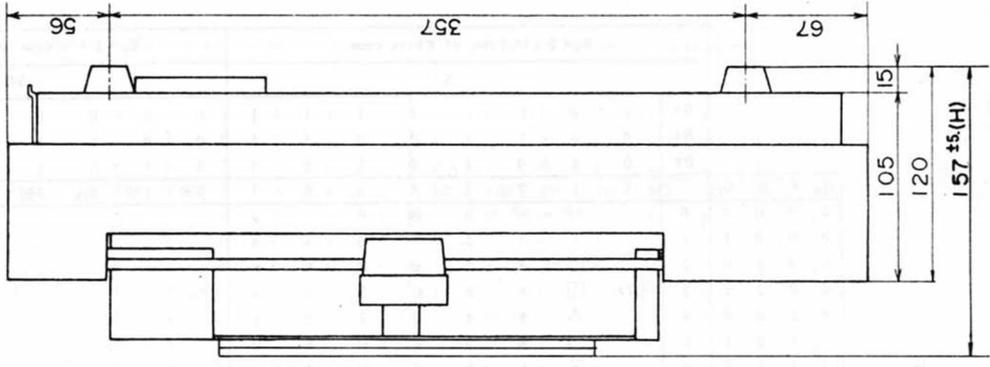
					B ₈ = 0 (In case of 8bits code)								B ₈ = 1 (In case of 8bits code)									
					S1								S0									
					B7	0	0	0	0	1	1	1	1	B7	0	0	0	0	1	1	1	1
					B6	0	0	1	1	0	0	1	1	B6	0	0	1	1	0	0	1	1
					B5	0	1	0	1	0	1	0	1	B5	0	1	0	1	0	1	0	1
B ₄	B ₃	B ₂	B ₁		0	1	2	3	4	5	6	7	0(8)	1(9)	2(A)	3(B)	4(C)	5(D)	6(E)	7(F)		
0	0	0	0	0		SP	SP	0	@	P	'	p		SP	SP	-	タ	ミ	SP	π		
0	0	0	1	1		·	!	1	A	Q	a	q		Γ	ο	ア	チ	ム	α	ρ		
0	0	1	0	2		◇	#	2	B	R	b	r		Δ	「	イ	ツ	メ	β	σ		
0	0	1	1	3	ETX	□	£	3	C	S	c	s	ETX	Z	」	ウ	テ	モ	γ	τ		
0	1	0	0	4		△	\$	4	D	T	d	t		(H)	·	エ	ト	ヤ	δ	υ		
0	1	0	1	5		⊙	¢	5	E	U	e	u		Λ	·	オ	ナ	ユ	ε	φ		
0	1	1	0	6		⊗	&	6	F	V	f	v		(H)	ヲ	カ	ニ	ヨ	ζ	χ		
0	1	1	1	7		×	/	7	G	W	g	w		O	フ	キ	ス	ラ	η	φ		
1	0	0	0	8	BS	+	(	8	H	X	h	x	BS	Π	イ	ク	ネ	リ	θ	ε	
1	0	0	1	9		Y	)	9	I	Y	i	y		Σ	ク	ケ	ノ	ル	ι	≡	
1	0	1	0	A	LF	⊕	*	:	J	Z	j	z	LF	Υ	エ	コ	ハ	レ	κ	≡		
1	0	1	1	B		⊗	+	:	K	i	k	|		Φ	+	サ	ヒ	ロ	λ	±		
1	1	0	0	C		⊗	,	<	L	Ñ	l	|		Ψ	+	シ	フ	ワ	μ	⊕		
1	1	0	1	D	CR	⊗	-	=	M	¿	m	}]	CR	Ω	ユ	ス	ヘ	ン	ν	⊕		
1	1	1	0	E	SO	*	·	>	N	^	n	-	SO	SP	ヨ	セ	ホ	ミ	ξ	∞		
1	1	1	1	F	SI	☆	/	?	O	-	o	-	SI	SP	ッ	ソ	マ	ο	ο	ο		

Note : SP is space code
: Not used undefined code

Appendix Code Table 2-11 FONT \$ 10,

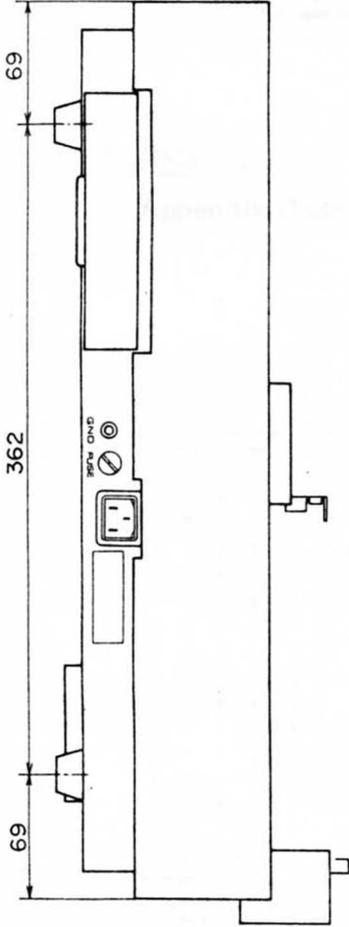
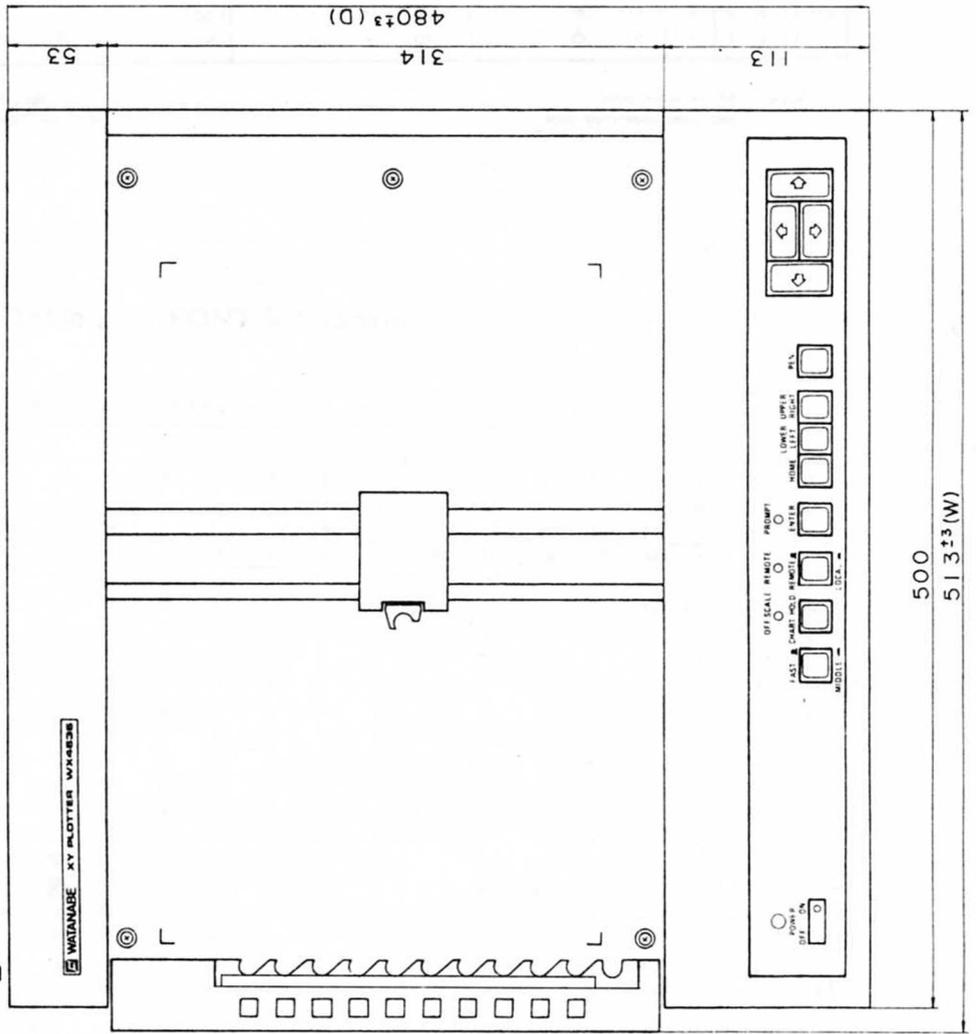
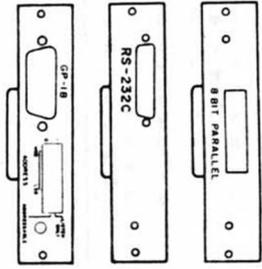
					B ₃ = 0 (In case of 8bits code)								B ₃ = 1 (In case of 8bits code)									
					SI								SO									
B ₇	B ₆	B ₅	B ₄	B ₃	B ₂	B ₁	0	1	2	3	4	5	6	7	0(8)	1(9)	2(A)	3(B)	4(C)	5(D)	6(E)	7(F)
0	0	0	0	0	0	0			SP	SP	0	@	P	'	p				SP	P	SP	π
0	0	0	0	1	1	1			·	!	1	A	Q	a	q				A	Σ	α	ρ
0	0	1	0	0	2	2			◇	#	2	B	R	b	r				B	T	β	σ
0	0	1	1	3	3	3	ETX	□	#	3	C	S	c	s	ETX				Γ	Υ	γ	τ
0	1	0	0	4	4	4			△	\$	4	D	T	d	t				Δ	Φ	δ	υ
0	1	0	1	5	5	5			⊖	%	5	E	U	e	u				E	X	ε	φ
0	1	1	0	6	6	6			⊗	&	6	F	V	f	v				Z	Ψ	ζ	χ
0	1	1	1	7	7	7			⊗	'	7	G	W	g	w				H	Ω	η	φ
1	0	0	0	8	8	8	BS	+	(	8	H	X	h	x	BS				Ⓜ		θ	ω
1	0	0	1	9	9	9			Y	)	9	I	Y	i	y				K		ι	≡
1	0	1	0	A	A	A	LF	⊕	*	:	J	Z	j	z	LF				Λ		κ	≡
1	0	1	1	B	B	B			⊗	+	;	K	[	k	{				M		λ	±
1	1	0	0	C	C	C			⊗	,	<	L	\	l	;				N		μ	€
1	1	0	1	D	D	D	CR	⊗	-	=	M	)	m	}	CR				Ⓜ		ν	⊗
1	1	1	0	E	E	E	SO	⊗	·	>	N	↑	n	~	SO				O		ξ	∞
1	1	1	1	F	F	F	SI	⊗	/	?	O	←	o		SI				Π		ο	

Note : SP is space code
: Not used undefined code



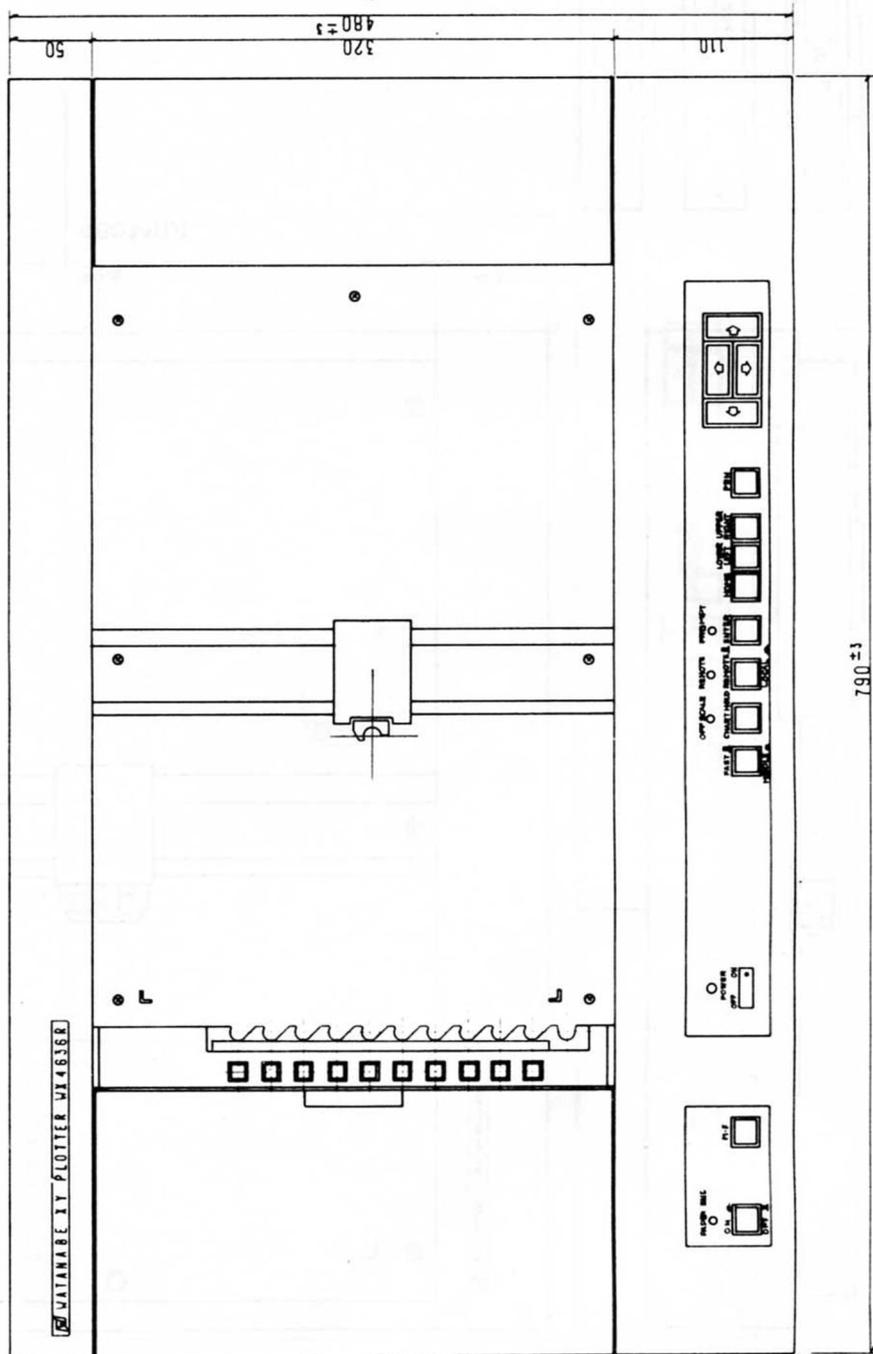
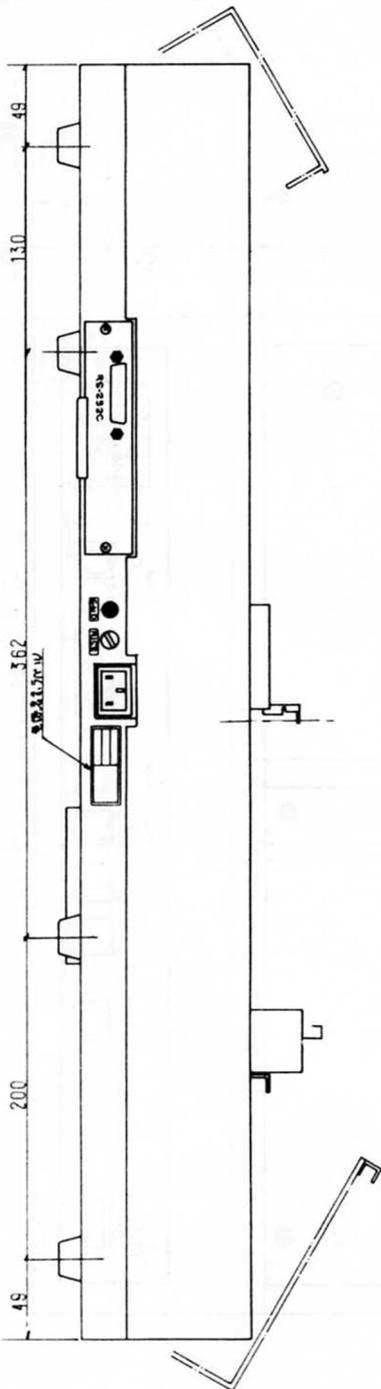
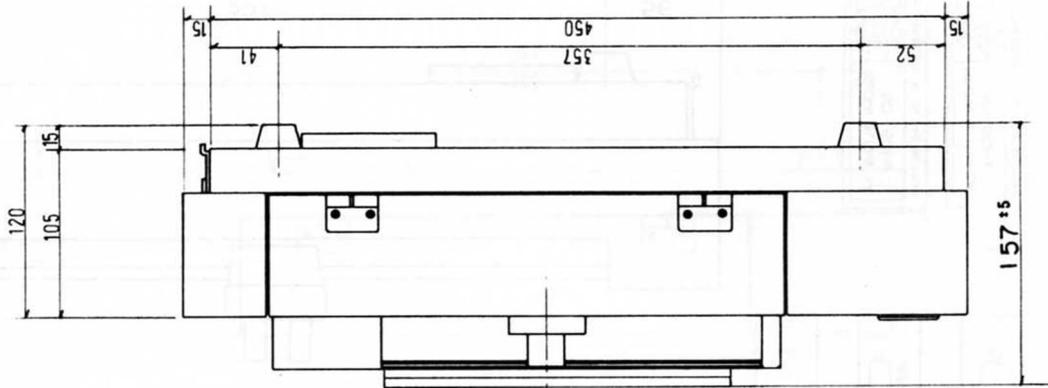
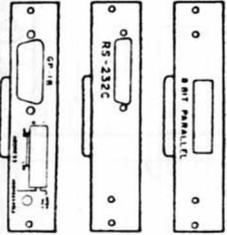
AC2200V	SLOW BLOW 1A
AC2200V	50-60Hz
AC2240V	50-60Hz
POWER SELECTOR IS ON THE BOTTOM	

AC100V	SLOW BLOW 2A
AC110V	50-60Hz
AC117V	50-60Hz
POWER SELECTOR IS ON THE BOTTOM	

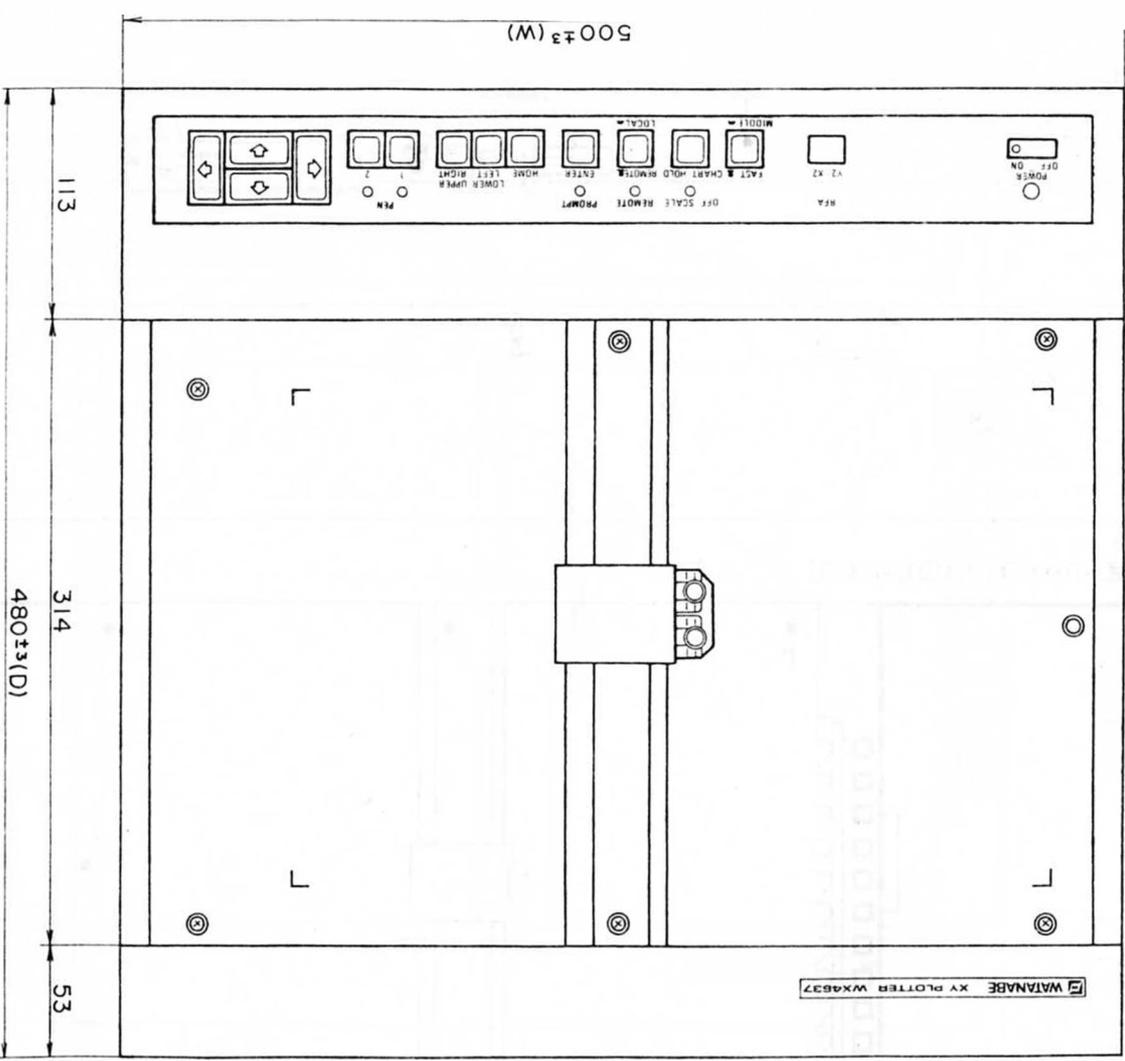
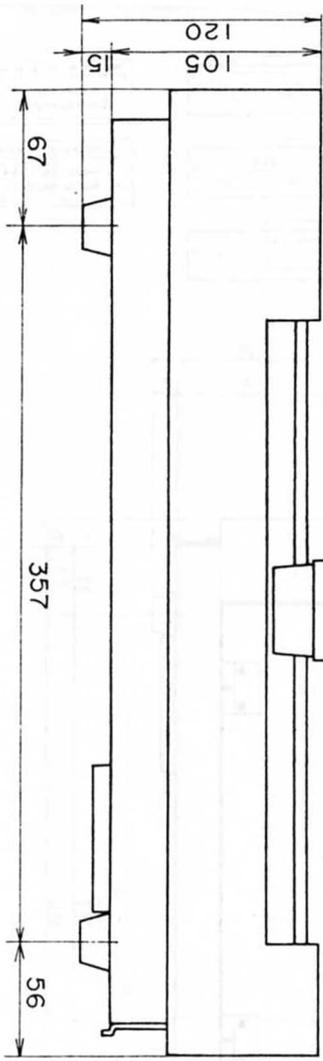


WX4636

AC220V	SLOW BLOW 1A
AC220V	50-60Hz
AC220V	
POWER SWITCHES & ON THE BOTTOM	



WX4636R



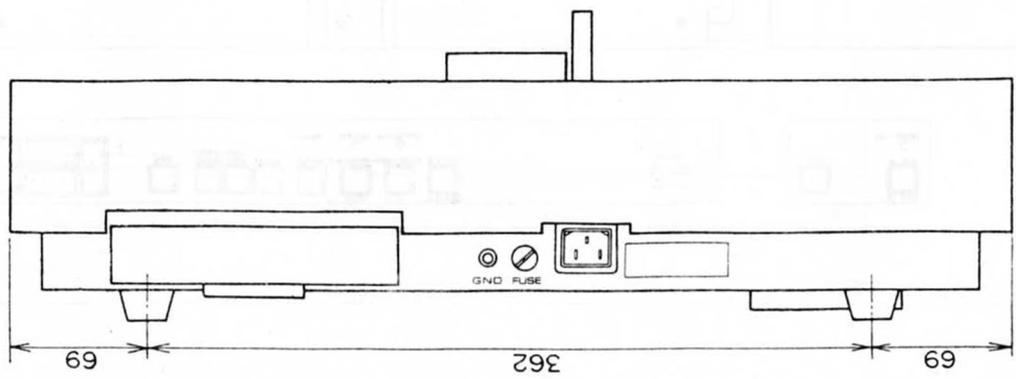
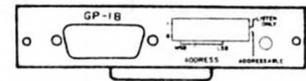
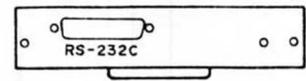
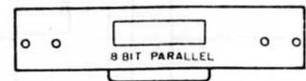
WX 4 8 3 7

AC200V	SLOW BLOW 1A
AC220V	50-60Hz
AC240V	

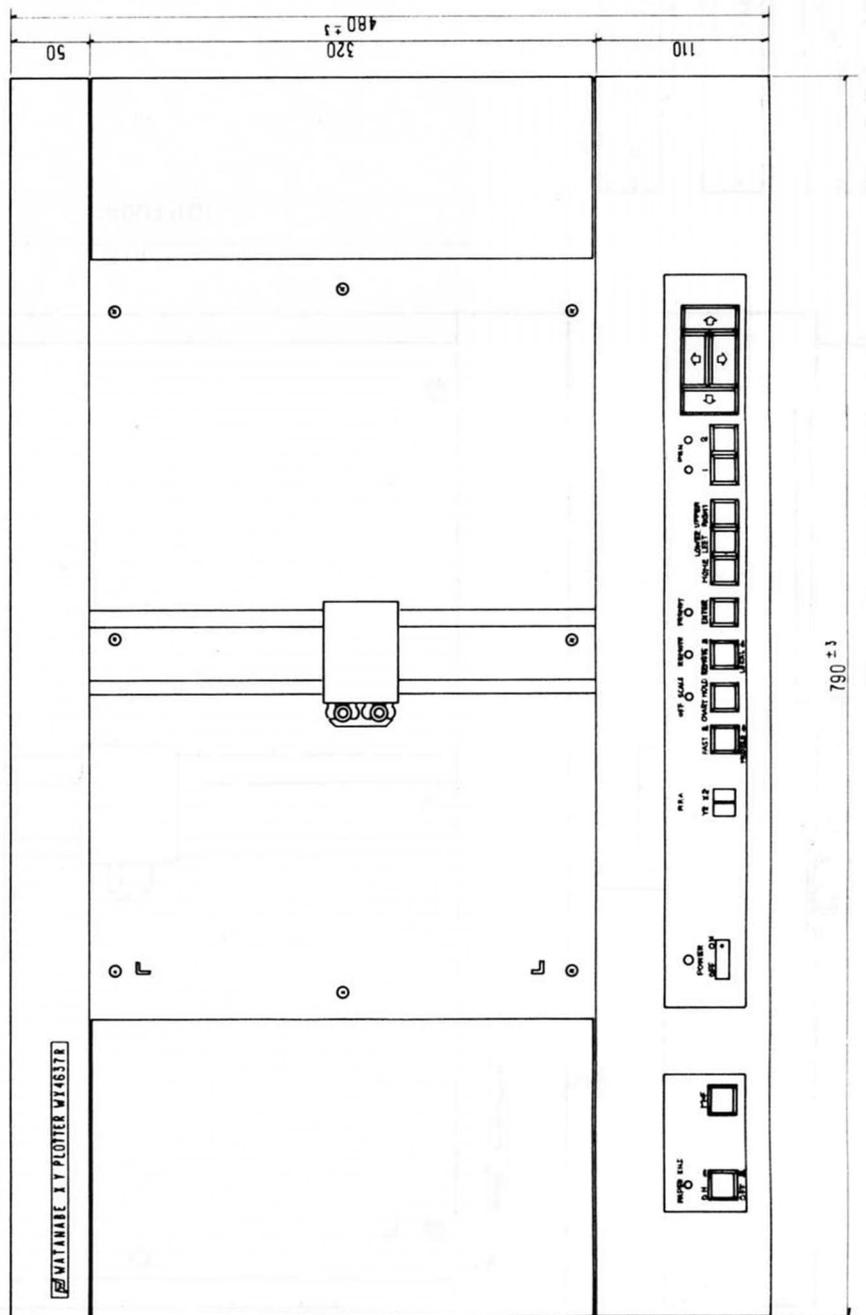
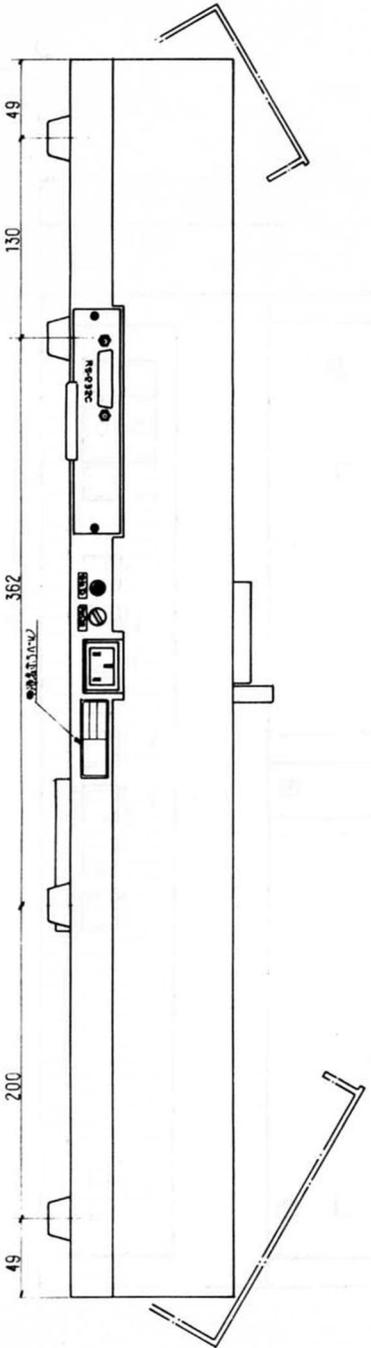
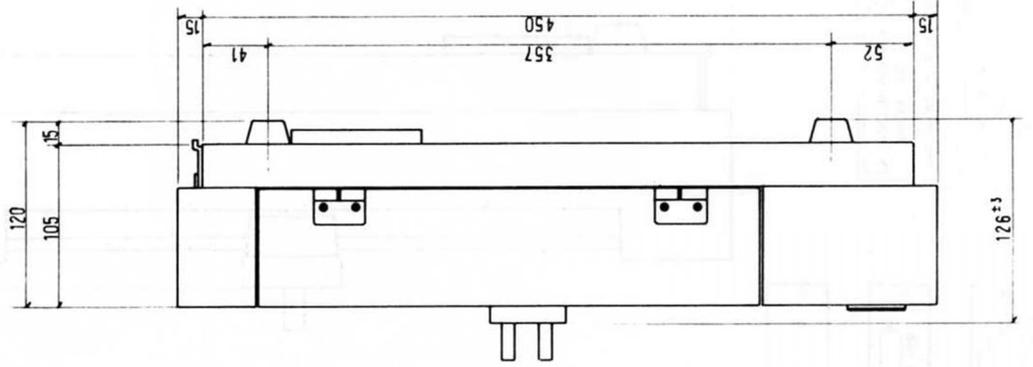
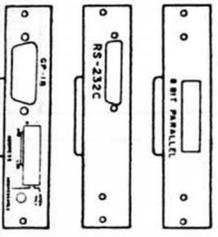
POWER SELECTOR IS ON THE BOTTOM.

AC100V	SLOW BLOW 2A
AC110V	50-60Hz
AC117V	

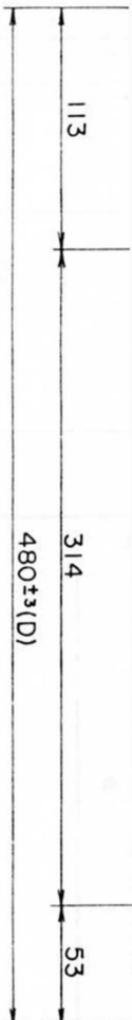
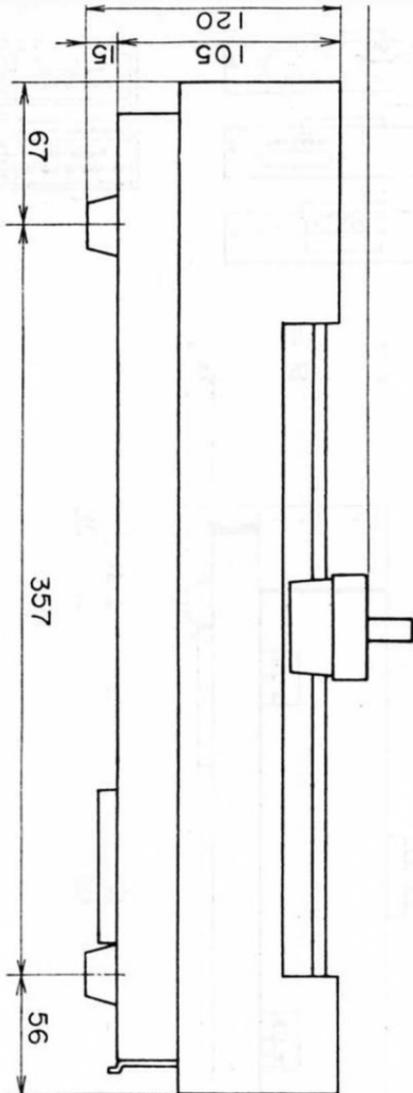
POWER SELECTOR IS ON THE BOTTOM.



AC300V / AC320V / AC340V	SLOW BLOW 1A SO-804H
POWER SELECTOR IS ON THE BOTTOM	
AC100V / AC110V / AC117V	SLOW BLOW 2A SO-804H
POWER SELECTOR IS ON THE BOTTOM	

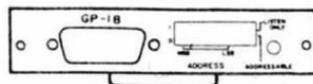
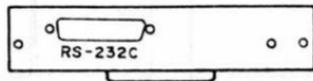
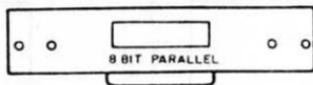


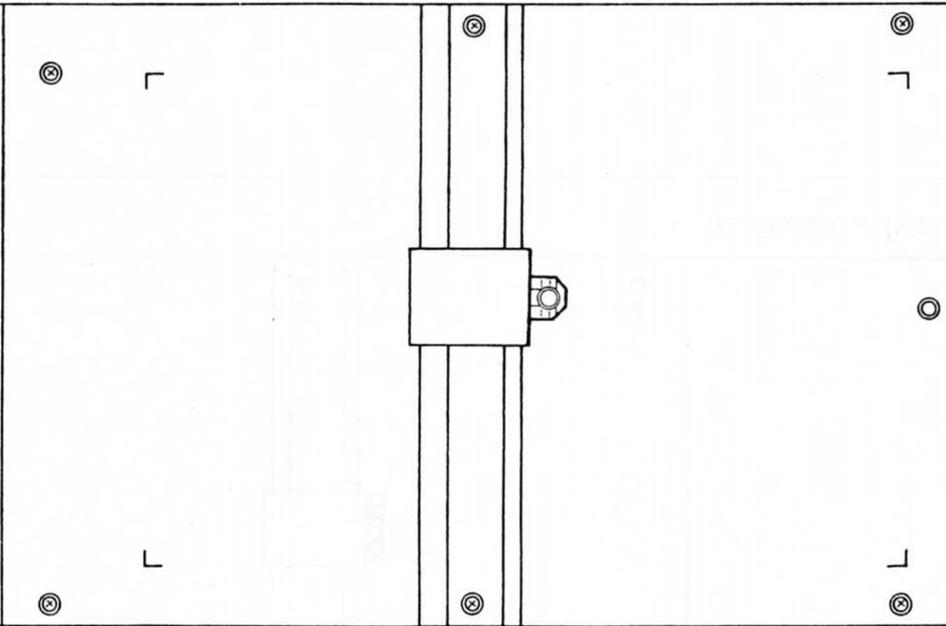
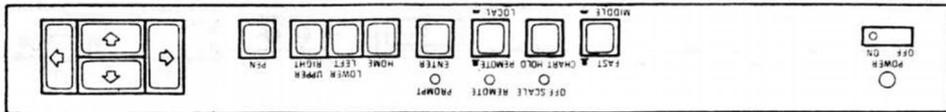
WX4637 R



AC200V	SLOW BLOW 1A 50-60Hz
AC220V	
AC240V	
POWER SELECTOR IS ON THE BOTTOM	

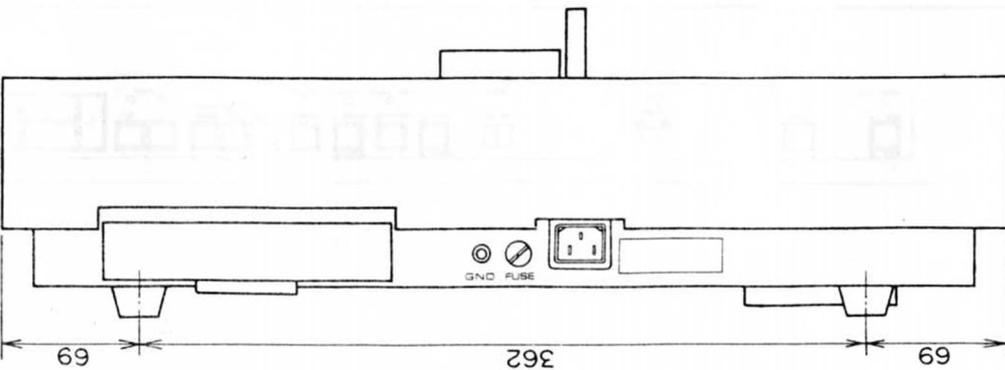
AC100V	SLOW BLOW 2A 50-60Hz
AC110V	
AC117V	
POWER SELECTOR IS ON THE BOTTOM	





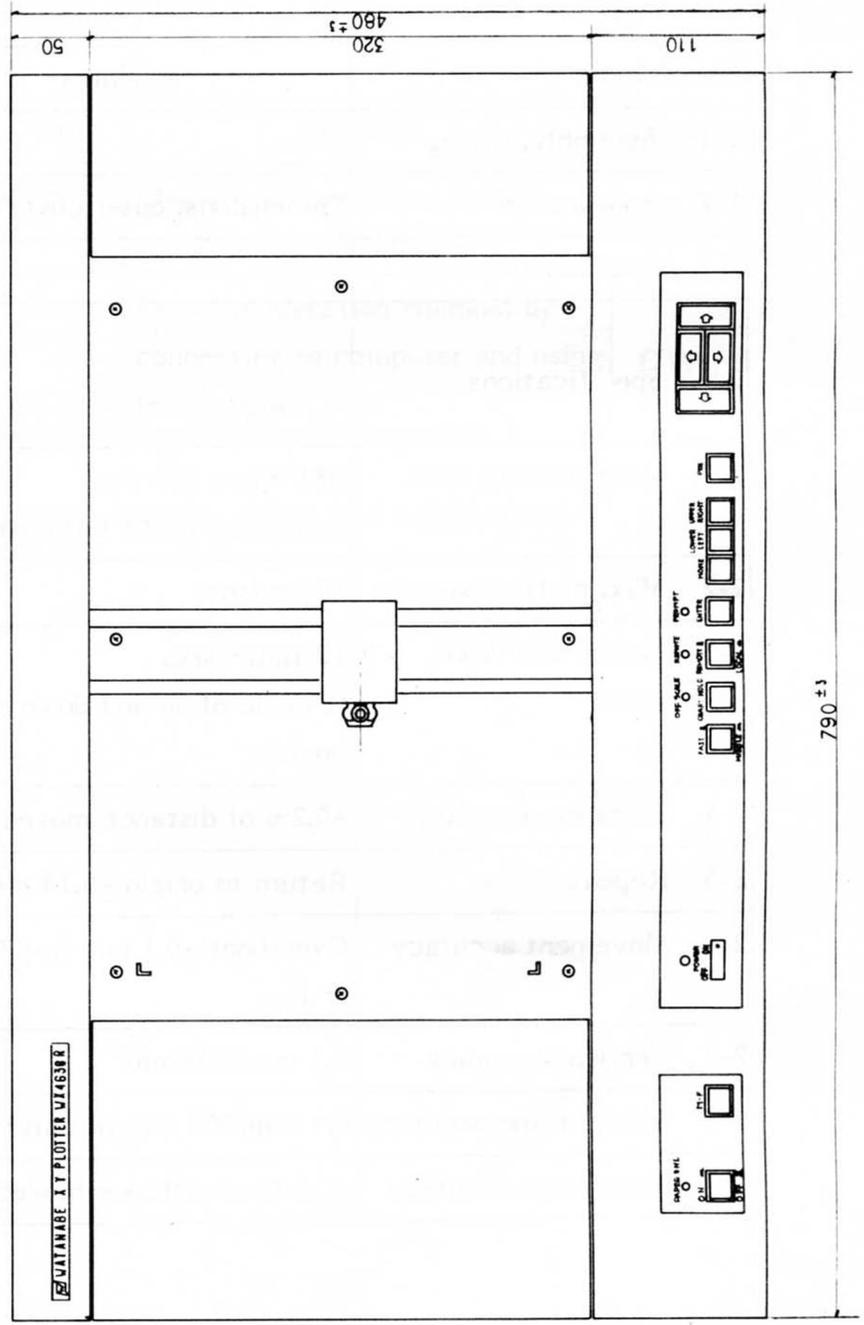
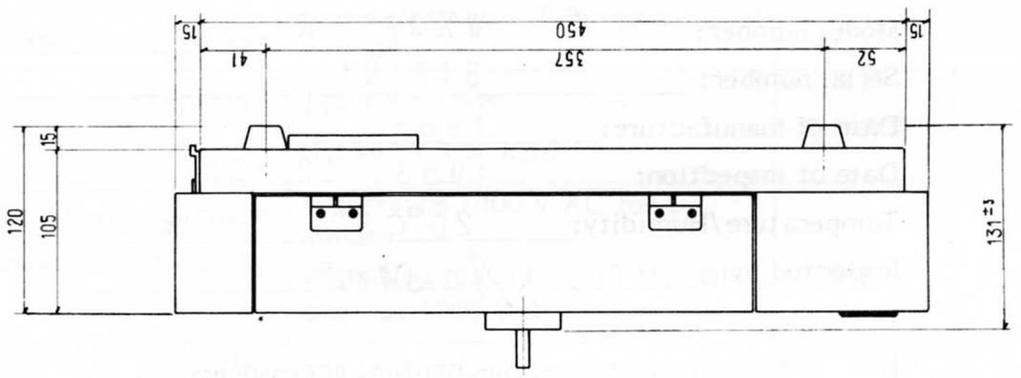
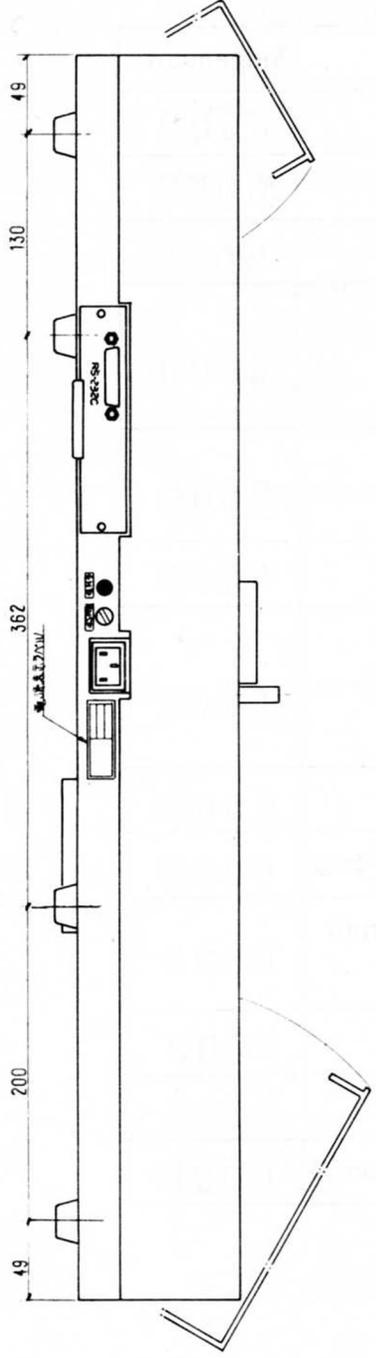
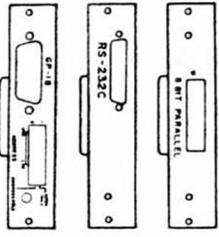
WATNABE XY PLOTTER WX4638

WX 4 6 3 8



ACT/ON/	SI QW BLOW 2A
ACT/IV/	50-80Hz
POWER SELECTOR 8 ON IN POSITION	

ACT/ON/	SI QW BLOW 1A
ACT/ON/	50-80Hz
POWER SELECTOR 8 ON IN POSITION	



WX 4 6 3 8 R

Inspection Chart

Model number: WX 4636 R
 Serial number: 312191
 Date of manufacture: 1983 12
 Date of inspection: 1983 12 28
 Temperature/Humidity: 20°C 50 %
 Inspected by: A. SATO

1. External appearance, mechanism, accessories

Check item	Remarks	Judgement
1-1 Assembly, wiring		GOOD
1-2 Appearance	Dimensions, outer covering	GOOD
1-3 Accessories		GOOD
2. Specifications		GOOD
2-1 Valid plotting area	381 mm x 254 mm (accuracy $\pm 0.2\%$ both axes)	GOOD
2-2 Max. plotting speed	40 cm/sec.	GOOD
2-3 Pen up and down speed	12 times/sec. (1 cycle of up and down counts as once.)	GOOD
2-4 Distance accuracy	$\pm 0.2\%$ of distance moved.	GOOD
2-5 Repeatability	Return to origin ± 0.15 mm or less	GOOD
2-6 Movement accuracy	Overshoot ± 0.1 mm (p-p 0.2 mm) or less	GOOD
2-7 Vertical accuracy	0.3 mm/250 mm	GOOD
2-8 Straight line accuracy	0.4 mm/500 mm (R only)	GOOD
2-9 Paper feed accuracy	± 0.5 % of distance moved (R only)	GOOD

Check item	Remarks	Judgement
2-10 Power supply voltage	Can withstand +10 % variation of voltage	GOOD
2-11 Power consumption	140 VA or less (R: 165 VA or less)	GOOD
2-12 Insulation-endurance Power source-casing	Withstands 1000 V AC for 1 minute Insulation resistance 10 M Ω or more at 1000 V DC	GOOD

3. Functions

Check item	Remarks	Judgement
3-1 Operating function	Check each operation switch and function display.	GOOD
3-2 Standard programmable function	Drawing operation checked by connecting to computer and using test program	GOOD

Note: R is the model with recording paper feed mechanism.

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MINATO-KU, TOKYO 108, JAPAN

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TELEX : 02422687 (GRAPH-J)

(Former Watanabe Instruments Corp.)