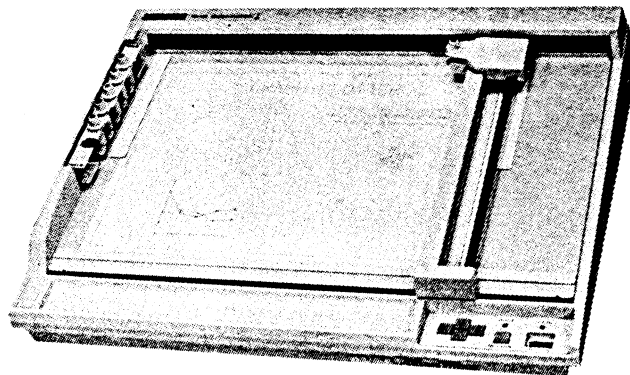


GRAPH PLOTTER
MODEL 671-20
OPERATING GUIDE



N-1280E-1
YS-Y (HTT-LT)

X-Y PLOTTER

MODEL 671-20

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THIS CHAPTER IS USED FOR SERVICE PERSONAL ONLY

1. DANGER

AC is present on the fuse(s) whether the main power switch is "ON" or "OFF" disconnect the AC power cable from the source before removing the fuse(s) cover. Before removing cover, read safety notice of the operating manual. AC is present on the main printed circuit board at all times.

2. WARNING

AC fuses are located inside cover on the main PCB.

Line	Type	Rating
200 ~ 240 V AC	ULCS-61M-3	3A

-risk of fire-

To prevent possibility of fire

"Fuse replacement must be the same type and rating."

3. WARNING

"Computer disks may be damaged if laid on the plotter due to paper hold-down strips being magnetic."

1. GENERAL

1.1 Introduction

The MODEL 671-20 is a flat-bed type X-Y plotter for A3 size chart, and is connected to a personal computer and records drawings and characters. With this model, figures and graphs can be drawn handily and colorfully with 6-colored pens on A3 or smaller sized chart.

1.2 Features

- o Abundant drawing commands

20 kinds of drawing commands are provided for characters (ASCII code), lines, circles and arcs etc.

- o High speed and high resolution

Pen speed: 200 mm/s max. (axial direction)
Step size: 0.1 mm (0.05 mm for internal processing)
This makes for a high-performance plotter.

- o Multi-colored drawing by means of automatic pen exchange

Colorful drawing can be made due to automatic exchange of 6 pens. Aqueous and oily fiber-tip pens, aqueous plastic pen and ceramic pen can be used.

The oily fiber-tip pen makes it possible to draw figures clearly for an overhead projector (OHP).

2. NOTES ON USE

For making the best use of the functions of this plotter, keep the following points in minds.

- (1) Select an installation place which meets the requirements listed below.
 - o Free from mechanical vibrations and electrical noise.
 - o Free from dust and high humidity (humidity should be within 45 to 85 % RH).
 - o Protected from direct sunlight and drafts.
 - o A normal temperature (20° C) is maintained, with little temperature variation.
 - o Place the plotter on a level and solidly-built stand or desk.
- (2) Supply voltage is 200 ~ 240 V AC. Voltage higher than this is not allowed.
- (3) Do not move the Y-axis shaft or pen carriage by hand when the power is ON. Be sure to move it via the position switches (on the control panel). If moving it by hand is unavoidable, turn the power OFF first and then move it gently.
- (4) Do not forcedly depress or bend the pen carriage, Y-axis shaft, pen stocker etc.
- (5) Observe the following with regard to the chart table.
 - o Avoid doing other work or putting heavy objects on it. If the table is scratched, injured or bent, drawings may not be drawn well.
 - o When the table is stained with ink etc., wipe it off with a water- or alcohol-soaked soft cloth or tissues. Solvents such as thinner or trichloroethylene should not be used for this.
 - o Do not touch the table with hands when a drawing is under way.
- (6) Do not put magnetic cards etc. on the chart holder. Otherwise, programs may be damaged.
- (7) This plotter has a clearance at its top and bottom. Be sure not to insert objects into there nor put metallic or small objects on the table. Insertion of objects into the clearance may cause an electric shock or fire.
- (8) Observe the following with regard to pen handling.
 - o Do not attach pens to the pen carriage before supplying power. Put them in the pen stocker.
 - o After finishing a drawing, cap the pens by all means. Take care of the oily fiber-tip pen in particular, for it dries quickly.
- (9) When connecting the plotter to a computer for the first time, be sure to conduct a self test for trial drawing and confirm that the plotter functions properly.

3. NAME AND FUNCTION OF EACH PART

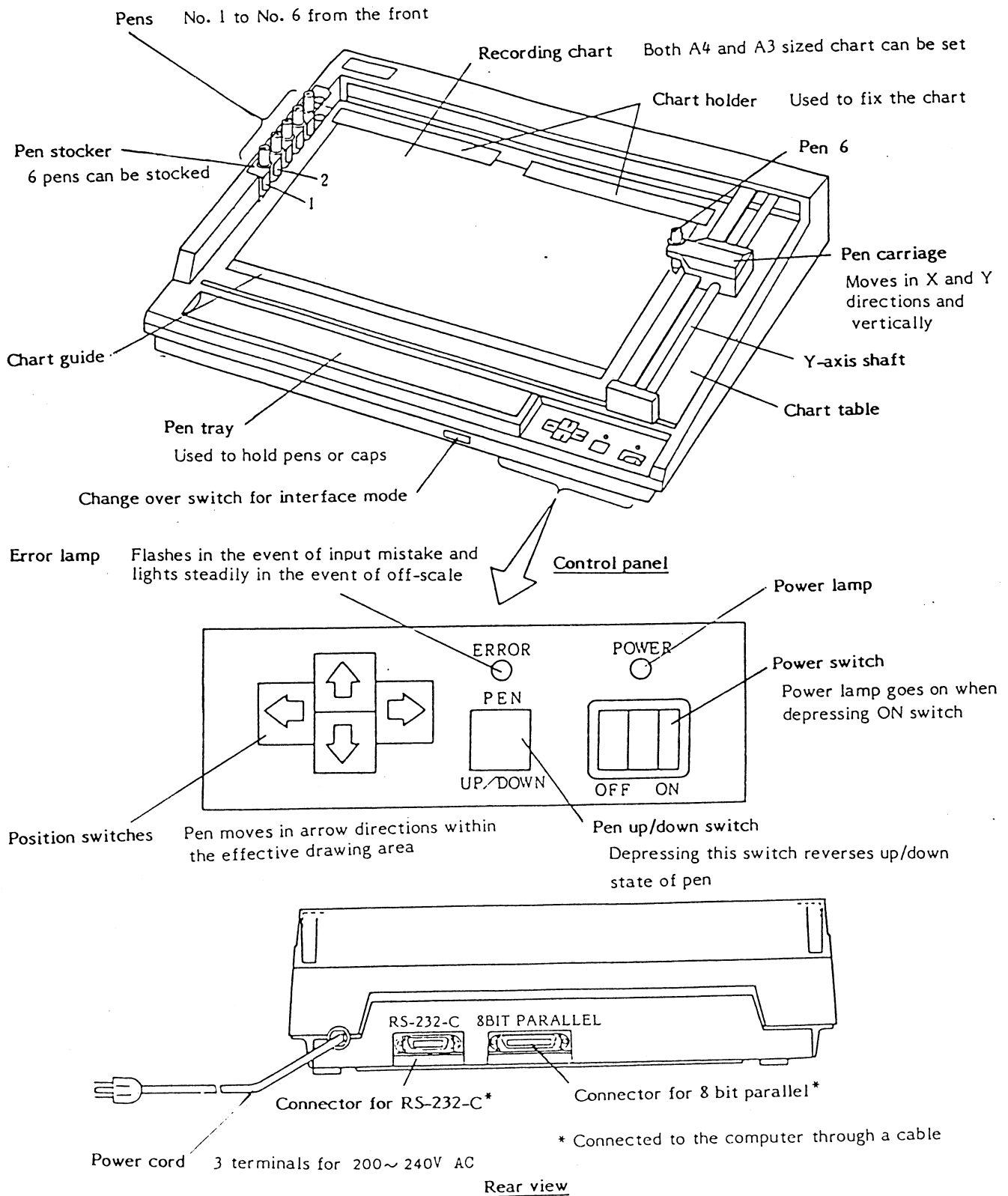


Fig. 3-1 Name and Function of Each Part

4. PREPARATIONS FOR DRAWING

4.1 Power Turn-on

Make sure first that the power switch is OFF and then connect the power cord to a 200~240 V AC socket.

Turn the power switch ON. Then, the power lamp goes on and the pen carriage moves to the top center.

4.2 Chart Setting

Set a chart (A3 size) on the chart table by sliding it under the Y-axis shaft from the right side of the table. Align the chart bottom with a chart setting reference line of the chart guide and fix the chart top with the chart holder. Take care that the chart holder does not come inside the effective drawing area (Fig. 4-1). Smoothen the chart so that it won't wrinkle or loosen.

It is all right to use general chart paper. It is recommended, however, that a standard chart (671-7501, 671-7502) or one equivalent or superior to it, on which ink won't stain, be used as far as possible.

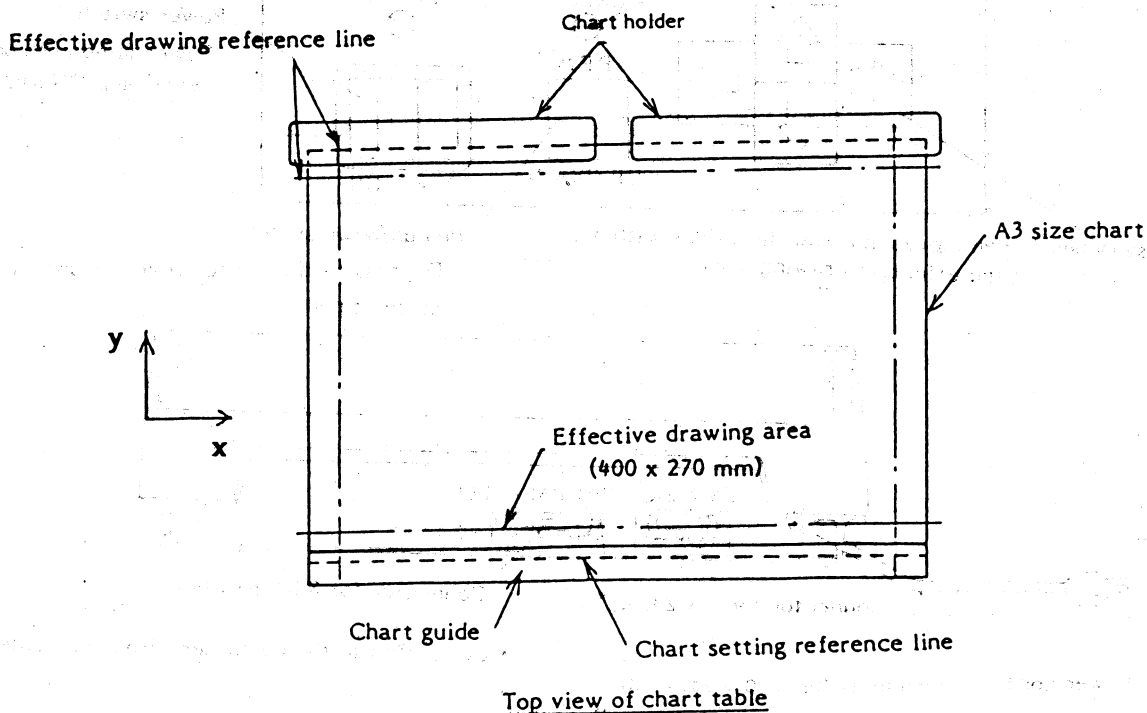


Fig. 4-1 Drawing Area and Chart Setting

4.3 Recorder Pen Setting

Aqueous fiber-tip pens (6 colors) are provided with this plotter as accessories. Take the caps off the pens and put the pens in the pen stocker from above (Fig. 4-2). Put the caps on the pen tray so as not to lose them. Take care in that incorrect pen settings may cause erroneous operation or trouble. If a pen is in the pen carriage, remove it from the carriage and set it to a pen position of the pen stocker. Aqueous plastic pen and oily fiber-tip pen can also be used for this plotter. Setting procedures are the same as described above.

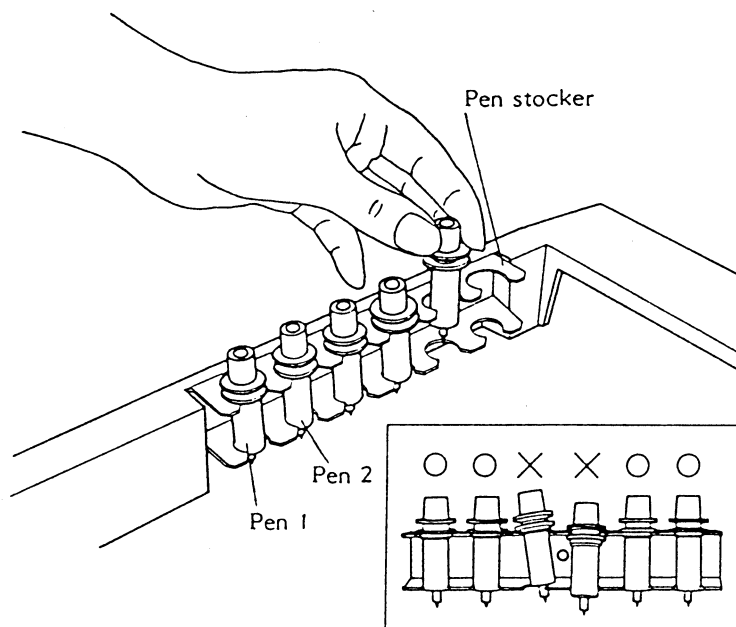


Fig. 4-2 Pen Setting

* Note on handling of oily fiber-tip

Compared with the aqueous fiber-tip pen and aqueous plastic pen, the oily fiber-tip pen dries very quickly. Therefore cap it soon after use. And prior to use, perform a trial writing by approx. 30 cm. If ink is clogged in the pen tip whereby it cannot draw, put it into alcohol for a few minutes to melt it. For the overhead projector (OHP) in particular, use a proper polyester film to obtain high quality drawing (Avoid electrification preventive processed films).

* How to set a ceramic pen

Put the ceramic pen (CERAMICRON of Pentel Co.) into a ceramic pen holder (sold separately) as shown in Fig. 4-3. Hold the pen holder with the left hand and turn the pen counterclockwise with the right hand for fixing it. Turn it until it stops (Fig. 4-4). Put the ceramic pen inserted in the pen holder into the pen stocker in the same manner as the fiber-tip or plastic pen.

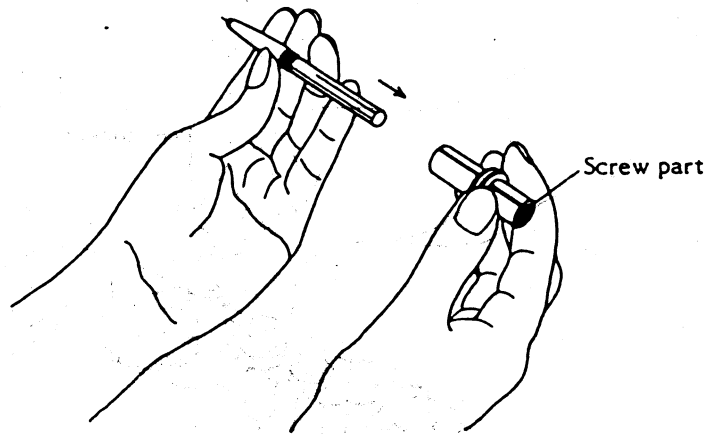


Fig. 4-3

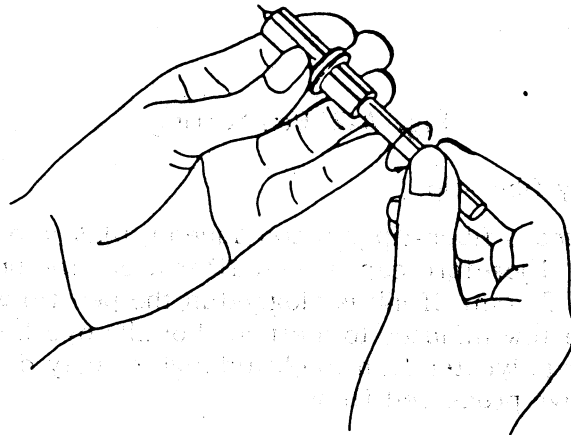




Fig. 4-4

4.4 Manual Operation Check

Manipulate the position switch on the control panel. It is all right if the pen carriage moves in the depressed switch direction within the effective drawing area on the chart table. The pen carriage never goes outside of the area even if depressing the switch. In case two switches are depressed at the same time,  takes precedence concerning the X-axis direction while  takes precedence in the Y-axis direction (Fig. 4-5).

Do not move the Y-axis shaft or pen carriage by hand when the power is ON, because the pen carriage may be damaged mechanically, resulting in troubles. If moving the pen carriage by hand is unavoidable, turn the power OFF first and move it gently.

Up/down of the pen can be reversed by depressing the pen up/down switch. However, the pen automatically rises unless the position switch and pen up/down switch are depressed within approx. 2 seconds after lowering the pen.

The manual operation check is thus finished.

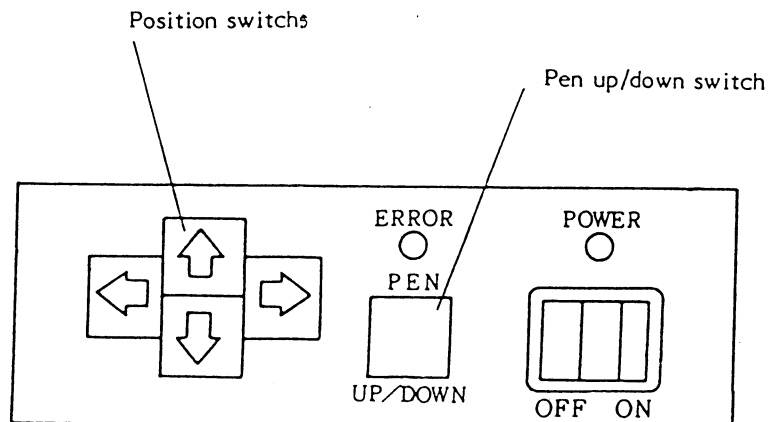


Fig. 4-5 Control Panel

4.5 Self-test

Next, self-test patterns must be drawn for an operational check of drawing commands. Turn the power OFF first and then make sure the chart is set, pens (6 pcs.) are provided and, in addition, there is no pen in the pen carriage.

Then turn the power ON while depressing position switches **[1]** and **[0]** (Fig. 4-6) and the plotter draws self-test patterns shown in Fig. 4-7.

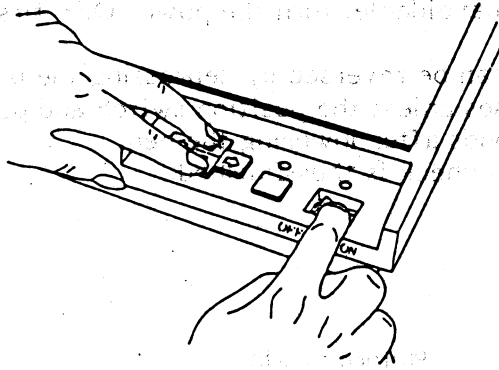


Fig. 4-6

Drawings are not made by depressing the position switch after turning the power ON. And when supplying power once again, wait approx. 5 seconds before turning power switch ON. The plotter is functioning normally if it can draw the same patterns as illustrated in Fig. 4-7. When all of the drawings have been made, the pens are put back in the pen stocker and the pen carriage goes to the top center position and stops there. The operational check of the graph plotter excluding the interface is now finished.

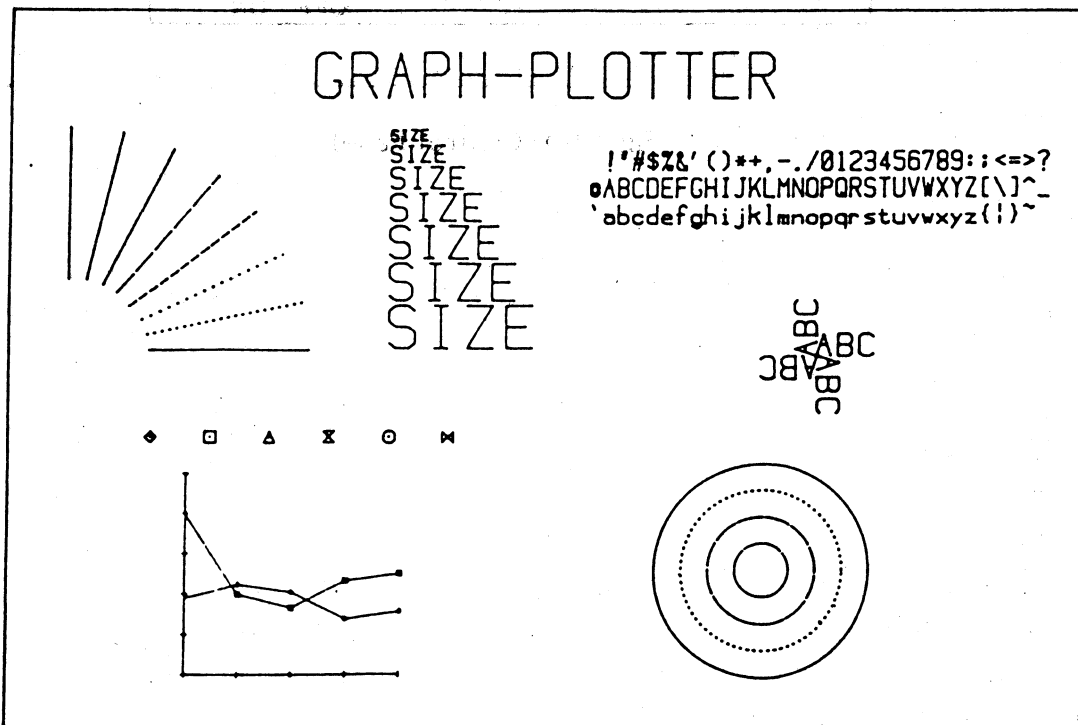


Fig. 4-7 Self-test Patterns

5. INPUT/OUTPUT INTERFACE

5.1 Connection of Input/Output Connector

5.1.1 8-bit Parallel Interface

This plotter utilizes an 8-bit parallel interface which is based on the Centronix specifications. Parallel interface connector is provided in the center of the plotter rear (Fig. 3-1). Pin arrangement and terminals are as shown in Fig. 5-1 and Table 5-1 below. Be sure to secure clamps on both sides after inserting the connector.

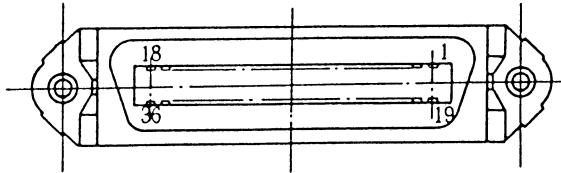


Fig. 5-1 Pin Arrangement in Parallel Interface Connector

(1) Parallel Interface Connector

Adaptive connector —36 pin type
57L-40360-2700 (D5) (DDK, AMPHENOL) or equivalent
Lock ————— Bail Lock type

(2) Specifications

- (a) Synchronization: By externally supplied STROBE pulses.
- (b) Handshaking: $\overline{\text{ACKNLG}}$ or BUSY signals.
- (c) Logic level: Input data and all interface control signals are compatible with the TTL level.

Table 5-1 Pin Assignment

Signal Pin No.	Return Pin No.	Signal	Direction	Description
1	19	STROBE	In	STROBE pulse to read data in. Pulse width must be more than 0.5 μ s at receiving terminal. The signal level is normally "HIGH"; read-in of data is performed at the "LOW" level of this signal.
2	20	DATA 1	In	These signals represent information of the 1st to 8th bits of parallel data respectively. Each signal is at "HIGH" level when data is logical "1" and "LOW" when logical "0".
3	21	DATA 2	In	
4	22	DATA 3	In	
5	23	DATA 4	In	
6	24	DATA 5	In	
7	25	DATA 6	In	
8	26	DATA 7	In	
9	27	DATA 8	In	
10	28	ACKNLG	Out	Approx. 5 μ s pulse. "LOW" indicates that data has been received and that the plotter is ready to accept other data.
11	29	BUSY	Out	A "HIGH" signal indicates that the plotter cannot receive data. The signal becomes "High" in the following cases: 1. During data entry 2. During plotting operation. 3. During plotter error status.
12	30	OV	Out	Logic GND level.
13	—	SLCT	Out	This signal indicates that the plotter is in the selected state.
14	—	NC	—	Not used.
15	—	NC	—	Not used.
16	—	OV	—	Logic GND level.

(cont'd)

Signal Pin No.	Return Pin No.	Signal	Direction	Description
17	—	CHASSIS-GND	—	Plotter chassis GND. In the plotter, the chassis GND and the logic GND are isolated from each other.
18	—	NC	—	Not used.
19-30	—	GND	—	TWISTED-PAIR RETURN signal GND level.
31	—	NC	—	Not used.
32	—	ERROR (Note 5)	Out	The level of this signal becomes "LOW" when the printer is in— { 1 : Invalid Input 2 : Out of effective parameter area.
33	—	GND	—	Same as with Pin No. 19 to 30.
34	—	NC	—	Not used.
35			Out	Pulled up to +5V through 10 K Ω resistance.
36	—	NC	—	Not used.

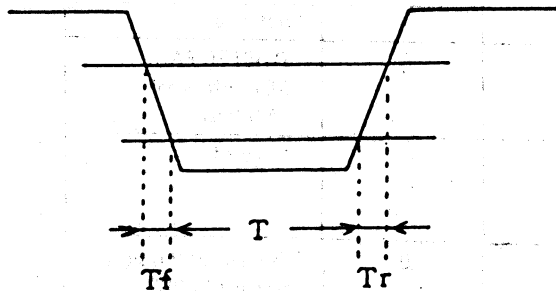
- NOTES
- 1: "Direction" refers to the direction of signal flow as viewed from the plotter.
 - 2: "Return" denotes "TWISTED PAIR RETURN" and is to be connected at signal ground level.
As to the wiring for the interface, be sure to use a twisted-pair cable for each signal and never fail to complete connection on the Return side. To prevent noise effectively, these cables should be shielded and connected to the chassis of the System Unit and the plotter respectively.
 - 3: All interface conditions are based on TTL level. Both the rise and fall times of each signal must be less than 0.2 μ s.
 - 4: Data transfer must not be carried out by ignoring the ACKNLG or BUSY signal. (Data transfer to this plotter can be carried out only after confirming the ACKNLG signal or when the level of the BUSY signal is "LOW".)
 - 5: ERROR---Plotter Generated
The ERROR line is a negative going signal to indicate there is a faulty condition as follows.
(a) Error due to Invalid Input
(b) Off-Scale of Pen

(3) Electrical conditions

(a) Signal levels

All input/output signals are TTL level.

"HIGH" level +2.4 ~ 5.0 V
 "LOW" level +0.0 ~ 0.4 V (for the input pins on the printer)



$T_f, T_r = 0.2 \mu s$ or less
 T is the value as shown in the timing chart.

(b) Input/output conditions

Except for the STROBE signals, all input/out signals are pulled up to +5 V through a $10 k\Omega$ resistor.

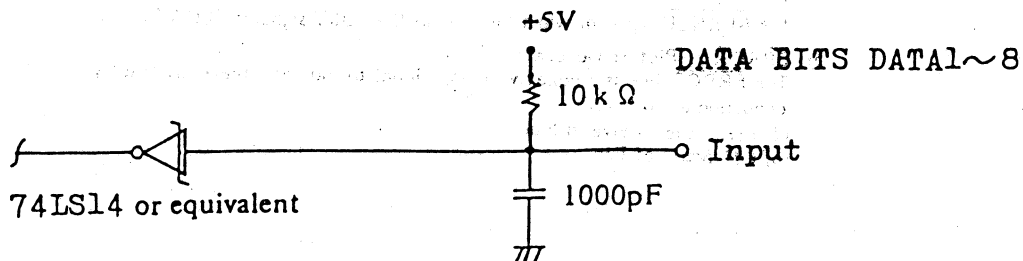
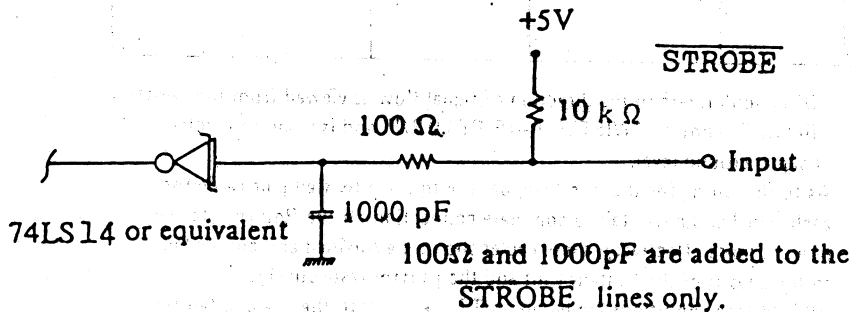
o Input signals

Input loading is a 74LS14 or equivalent.

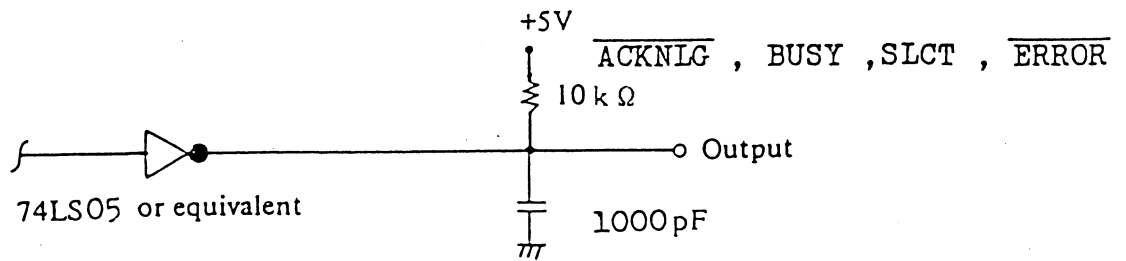
o Output signals

Outputs are through a 74LS05 or equivalent. Recommended loading is one TTL or LSTTL or the equivalent.

Receiver



Driver

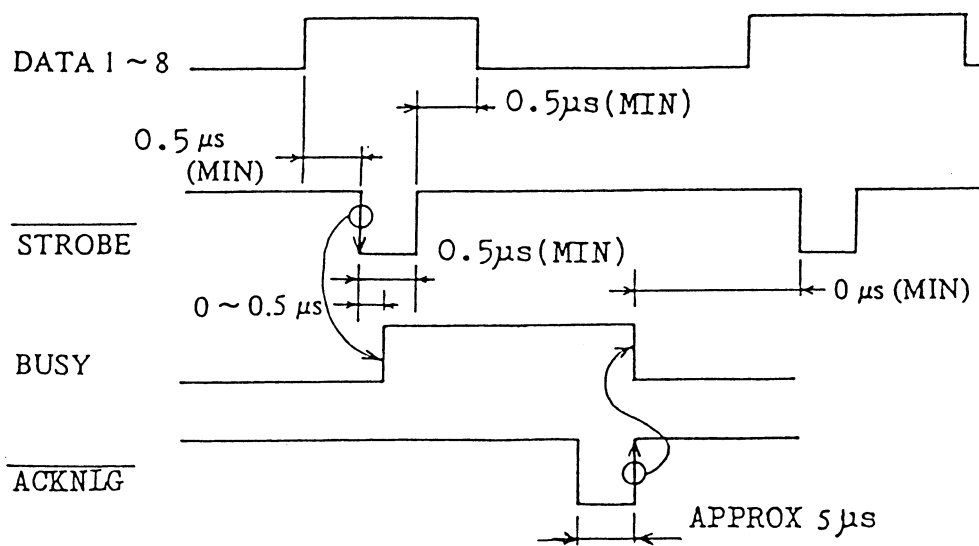


(c) Signal cable length

The maximum length is 2 meters and the following signals should be run as twisted pairs with the GND lines, or alternated with GND lines when flat cable is used.

$\overline{\text{STROBE}}$, BUSY , $\overline{\text{ACKNLG}}$, $\overline{\text{ERROR}}$, $\overline{\text{SLCT}}$

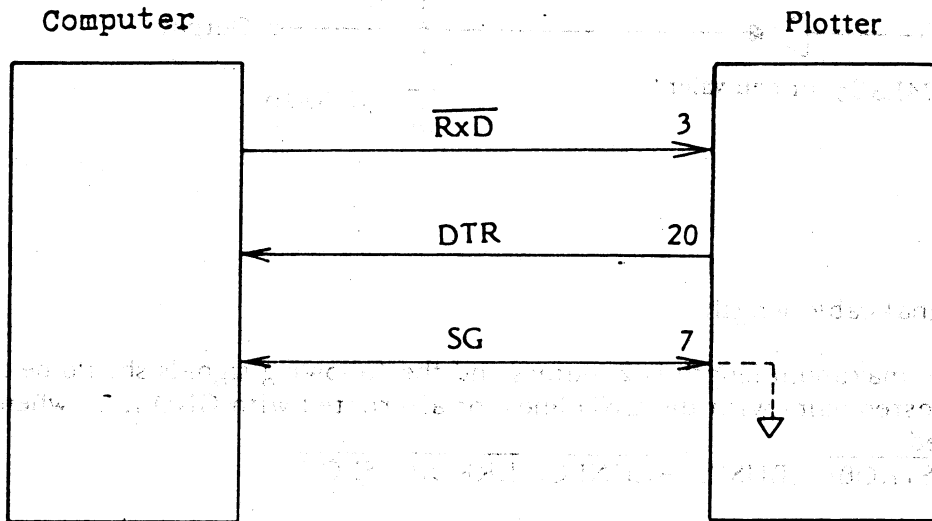
(d) Timing chart



5.1.2 RS-232-C Serial Interface

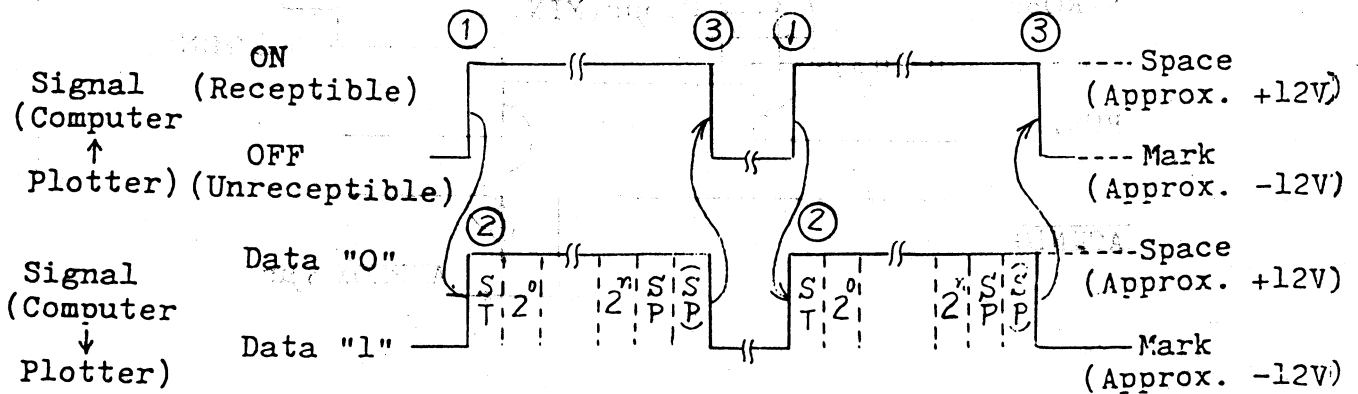
(1) Transmission Method

(a) Block diagram



$\overline{\text{RxD}}$: Receiving data
 DTR : Data terminal ready
 SG : Signal ground

(b) Procedure



Timing diagram

① As soon as data is receivable, the plotter turns DTR-signal to ON, and transmits it to computer.

② After confirming that DTR-signal is ON, through $\overline{\text{RxD}}$ line the computer transmits command signal and data signal to operate the plotter.

(Note) Be sure to transmit CR (Carriage Return) signal of ASCII code as termination at the end of data.

③ At each time of receiving one character $\overline{\text{RxD}}$ -signal, the plotter turns DTR-signal to OFF. And when detecting CR-signal in $\overline{\text{RxD}}$ -signals, the plotter stops communicating once and interprets meaning of the command from data stored in memory buffer and conducts the operation.

(2) Transmission Mode

(a) Mode : Asynchronous serial data communication
(Start bit/stop bit inserted)

(b) Baud rate : 300, 600, 1200, 2400, 4800 bauds

(c) Data format: Start bit 1
Data bit 7 or 8
Parity bit Odd, Even, or None
Stop bit 1 or 2

(Note) Transmission mode is selected by DIP switched on the front lower part of the plotter (See 5.1.3).

(3) Electric Characteristics

Input/output level

(a) Receiving data ($\overline{\text{RxD}}$)

Signal	Input level	Remarks
1 (mark)	-4~-12 V	Logical "1"
0 (space)	+4~+12 V	Logical "0"

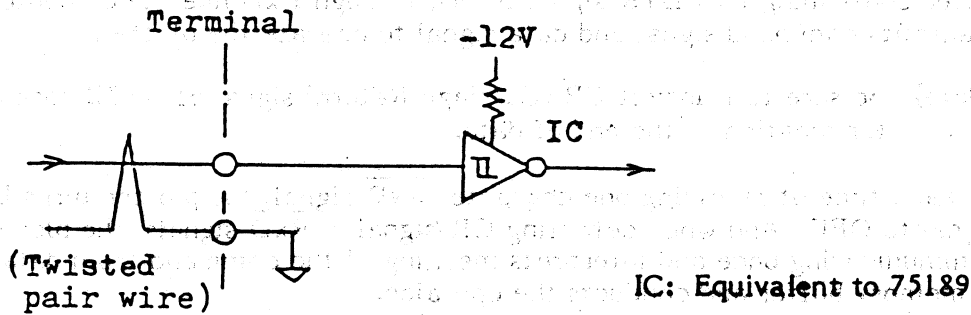
(b) Data terminal ready (DTR)

Signal	Input level	Remarks
ON	(typ) +6~+12 V	Plotter is in receivable condition.
OFF	(typ) -6~-12 V	Plotter is in unreceivable condition.

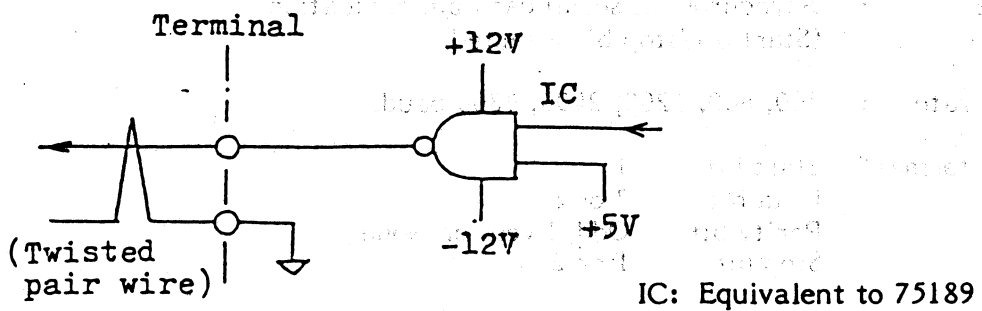
(Note) Load resistance: 3~7 k Ω

Input/output circuit

(a) Input ----- Signal $\overline{\text{Rx}}\text{D}$



(b) Output ----- Signal DTR



(4) Pin Assignment

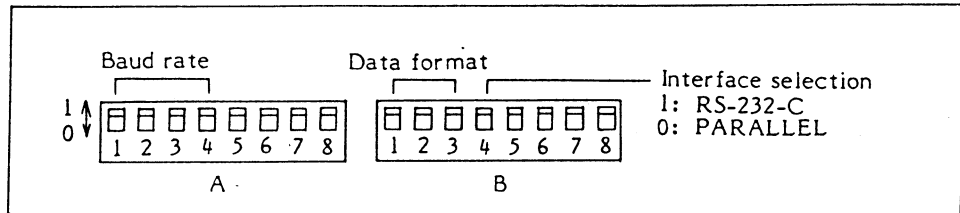
Signal direction (Computer ↔ plotter)	Signal name	Signal pin	Signal name	Signal direction (Computer ↔ Plotter)
↔	FG (*)	1 | 2		
→	$\overline{\text{Rx}}\text{D}$	3 | 4		
		5 | 6		
↔	SG	7 | 8		
		9 | 10		
		11 | 12		
		13 | 14		
		15 | 16		
		17 | 18		
		19 | 20	DTR	←
		21 | 22		
		23 | 24		
		25		

(Note) (*): Chassis grounded

Adaptive connector: Plotter end ----- DB-25S or equivalent
 Cable end ----- DB-25P or equivalent

5.1.3 Interface Setting

DIP switches



By changing-over DIP switches on the front lower part of the plotter shown in the above figure, interface conditions can be set. DIP switches must be changed over with the plotter power OFF. If DIP switches are changed over with the plotter power ON, interface conditions are not altered.

(1) Interface Selection

Parallel interface or RS-232-C serial interface is selected by DIP switch B-No. 4 (0: Parallel interface 1: RS-232-C serial interface)

(2) Data Format Selection

Data format is selected on the basis of the RS-232-C serial interface by DIP switches B-No. 1 through B-No. 3.

B-No. 1	B-No. 2	B-No. 3	Start bit	Data bit	Parity bit	Stop bit
0	0	0	1	7	Even	2
1	0	0	1	7	Odd	2
0	1	0	1	7	Even	1
1	1	0	1	7	Odd	1
0	0	1	1	8	None	2
1	0	1	1	8	None	1
0	1	1	1	8	Even	1
1	1	1	1	8	Odd	1

(3) Baud Rate Selection

Baud rate is selected on the basis of the RS-232-C serial interface by DIP switches A-No. 1 through A-No. 4.

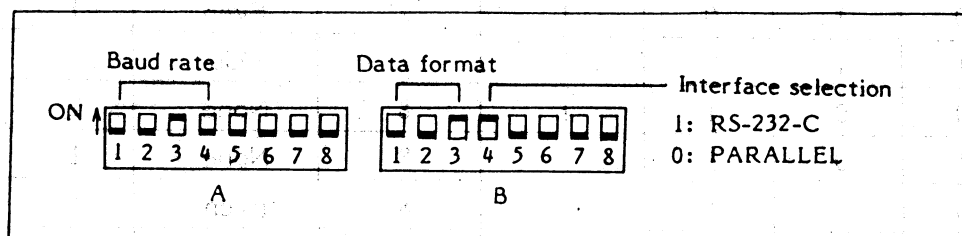
A-No. 1	A-No. 2	A-No. 3	A-No. 4	Baud rate
0	1	0	0	300 Baud
1	0	0	1	600 Baud
0	0	1	0	1200 Baud
1	1	0	0	2400 Baud
0	1	1	0	4800 Baud

(Note) DIP switches A-No. 5 through A-No. 8 and B-No. 5 through B-No.8 should always be set to 0.

Setting of DIP switches before shipment

The positions of the DIP switch heads shown under have been set before shipment.

DIP switches



Interface : RS-232-C
 Baud rate : 1200 baud
 Parity : none
 Data bit : 8 bits
 Stop bit : 2 bits

5.2 Input Data Code

Input data signals (DI0 to DI7) of the plotter are based on the ASCII code listed in Tables 5-2 and 5-3.

Hexadecimal 0A (line feed) and 0D (carriage return) are used as terminators. Even if vacant code is input, its data are ignored.

Table 5-2 ASCII Character Set Table

Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char
32	20	SPACE	64	40	␣	96	60	ˆ
33	21	!	65	41	A	97	61	␣
34	22	"	66	42	B	98	62	␣
35	23	#	67	43	C	99	63	␣
36	24	\$	68	44	D	100	64	␣
37	25	%	69	45	E	101	65	␣
38	26	&	70	46	F	102	66	␣
39	27	'	71	47	G	103	67	␣
40	28	(	72	48	H	104	68	␣
41	29	)	73	49	I	105	69	␣
42	2A	*	74	4A	J	106	6A	␣
43	2B	+	75	4B	K	107	6B	␣
44	2C	,	76	4C	L	108	6C	␣
45	2D	-	77	4D	M	109	6D	␣
46	2E	.	78	4E	N	110	6E	␣
47	2F	/	79	4F	O	111	6F	␣
48	30	0	80	50	P	112	70	␣
49	31	1	81	51	Q	113	71	␣
50	32	2	82	52	R	114	72	␣
51	33	3	83	53	S	115	73	␣
52	34	4	84	54	T	116	74	␣
53	35	5	85	55	U	117	75	␣
54	36	6	86	56	V	118	76	␣
55	37	7	87	57	W	119	77	␣
56	38	8	88	58	X	120	78	␣
57	39	9	89	59	Y	121	79	␣
58	3A	:	90	5A	Z	122	7A	␣
59	3B	;	91	5B	[	123	7B	{
60	3C	<	92	5C	\	124	7C	{
61	3D	=	93	5D	]	125	7D	}
62	3E	>	94	5E	^	126	7E	~
63	3F	?	95	5F	_	127	7F	ignored

(Note) ASCII is an seven-bit code. The most significant bit (b8) is always zero.





Table 5-3 European WP Character Set

Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char
128	80	Ç	160	A0	à	224	E0	α
129	81	Ü	161	A1	á	225	E1	β
130	82	ë	162	A2	â	226	E2	Γ
131	83	ö	163	A3	ã	227	E3	π
132	84	ä	164	A4	ä	228	E4	Σ
133	85	å	165	A5	å	229	E5	σ
134	86	ð	166	A6	æ	220	E6	μ
135	87	ç	167	A7	ç	221	E7	τ
136	88	è	168	A8	ê	232	E8	φ
137	89	é	169	A9	ë	233	E9	♦
138	8A	ê	170	AA	ì	234	EA	Ω
139	8B	ï	171	AB	í	235	EB	δ
140	8C	î	172	AC	î	236	EC	ø
141	8D	ï	173	AD	ï	237	ED	φ
142	8E	Ä	174	AE	«	238	EE	•
143	8F	Å	175	AF	»	239	EF	□
144	90	Æ				240	F0	▯
145	91	æ				241	F1	†
146	92	ø				242	F2	‡
147	93	ö				243	F3	¶
148	94	ö				244	F4	∟
149	95	ó				245	F5	∟
150	96	ó				246	F6	+
151	97	ü				247	F7	•
152	98	ÿ				248	F8	•
153	99	ö				249	F9	•
154	9A	ü				250	FA	•
155	9B	é				251	FB	•
156	9C	é				252	FC	•
157	9D	Y				253	FD	•
158	9E	R						
159	9F	F						

(Note) This character cannot be written when 7 data bits have been selected with use of the RS-232-C Interface.

Character	Hexadecimal code (Input format)	Decimal code (Input format)
α	E0 PRINT #1, "P"; CHR \$ (&HE0)	224 PRINT #1, "P"; CHR \$ (224)
Σ	E4 PRINT #1, "P"; CHR \$ (&HE4)	228 PRINT #1, "P"; CHR \$ (228)

6. PRINT MODE

Set the plotter into a print mode in the following manner and it regards keyed-in ASCII codes as print data for character printing. First, make sure that the power is OFF, and then turn the power switch ON while depressing the position switch (for X-axis direction), either  or  (Fig. 6-1). Then the pen carriage moves up to the top right position and stops there. With this, the plotter has been set in the print mode. It is not set in the print mode, however, by depressing either  or  after turning the power ON. Next, set the chart and pen 1 (With the print mode, only pen stocker No. 1 is used). Confirm there is no pen in the pen carriage.

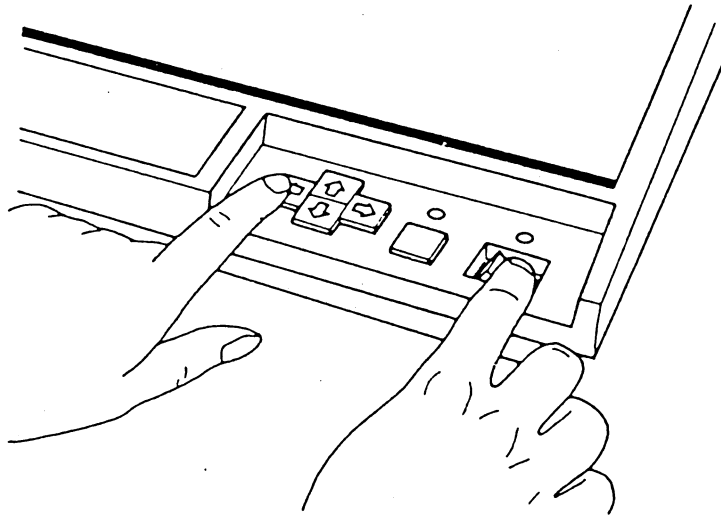







Fig. 6-1

The pen carriage moves left to pick up pen 1 as the ASCII code is keyed in and the pen begins printing the keyed-in character code from the top left in the effective drawing area. When any code not contained in the ASCII code table is keyed in, it is ignored. A new line is started when a terminator  (Line feed) is keyed in and the print is continued. If the next data are not keyed in 2 seconds after the line feed, however, the pen carriage puts the pen back in the No. 1 pen stocker and it goes back to its original position. Afterwards when a character code is keyed in, the pen carriage once again goes to pick up the pen and resumes printing from the position of the new line.

Character size is 3 mm high x 1.8 mm wide, with 132 characters per line and 56 lines per page. After the pen carriage has finished the 56th line, it goes to the top center and stops there with the pen up. If it is necessary to keep on printing further, first exchange the chart with a new one and then depress any one of position switches , , ,  and the pen carriage once again begins printing from the top left.

In the print mode, inputs from both position switches and pen up/down switch are ignored.

To cancel the print mode, turn the power switch OFF after confirming that the pen carriage has put the pen back in the pen stocker No. 1.

(Ex. 1) Printing of program list

CRT display

```
10 OPEN"O",#1,"LPT1:"
20 FOR I=1 TO 6
30 PRINT#1,"J";I
40 PRINT#1,"M";I*100+500;",";I*100+1000
50 PRINT#1,"E";I*100
60 NEXT I
70 PRINT#1,"J0"
80 PRINT#1,"H"
90 END
```

To have the plotter print this program list, set the plotter into the print mode first and then key in LIST "LPT1:", then the plotter prints as follows.

```
10 OPEN"O",#1,"LPT1:"
20 FOR I=1 TO 6
30 PRINT#1,"J";I
40 PRINT#1,"M";I*100+500;",";I*100+1000
50 PRINT#1,"E";I*100
60 NEXT I
70 PRINT#1,"J0"
80 PRINT#1,"H"
90 END
```

(Ex. 2) Key-in

After setting the plotter into the print mode, key in as follows.

```
OPEN"O",#1,"LPT1:"
PRINT#1,"ABCDEFGHabcdefgh"
PRINT#1,"HIJKLMN#$$&+*?"
```

Then the plotter prints as shown below.

```
ABCDEFGHabcdefgh
HIJKLMN#$$&+*?
```

(Note) These examples show the case of LPT1 port.

7. DRAWING COMMAND AND ITS FUNCTION

7.1 How to Give parameters for Drawing Command

This plotter is provided with 20 kinds of drawing commands, which are described in Table 7-1.

The command specifies a function (straight lines, circles, characters etc.) required for making drawings through only one capital English letter and then specifies parameters representing variables (coordinate values, shift values, size etc.) through numerals. However, command H, @ and Z require no parameters. In case two or more parameters are necessary, they are separated by a comma(,).

Upon keying in the terminator ($\boxed{\text{CR}}$ (carriage return) or $\boxed{\text{LF}}$ (line feed)) at the end, the command is completed and drawing begins.

In specifying parameter, observe the following points.

- o Key in all parameters by means of integers. If not an integer, it becomes erroneous.
- o Absolute values of parameters shall be within 4 digits.

(Ex.) D0100, 0200 $\boxed{\text{CR}}$ is equal to D100, 200 $\boxed{\text{CR}}$.
D12345, 100 becomes an error.
D-1234, 100 does not become an error.

- o Minimum unit of parameters for commands D, I, M, R, B, X, C, E, S, N and W which specify coordinate values, shift values and length is 0.1 mm. For instance, since step size of the plotter is 0.1 mm, when 1 is specified as a coordinate value, it means 0.1 mm step.

(Ex.) In case of "D100, 200", a straight line is drawn from the present pen position to x = 10 mm and y = 20 mm position.

- o All spaces other than with command P are ignored.

(Ex.) D 100 , 200 $\boxed{\text{CR}}$ is equal to D100, 200 $\boxed{\text{CR}}$.

- o In case of "CR" or "," without numerals, it means that "0" is keyed in as a parameter.

(Ex.) D, $\boxed{\text{CR}}$ is equal to D0, 0 $\boxed{\text{CR}}$.

D $\boxed{\text{CR}}$ is equal to D0, 0 $\boxed{\text{CR}}$.

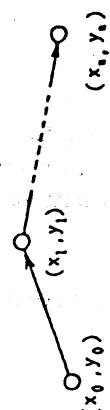
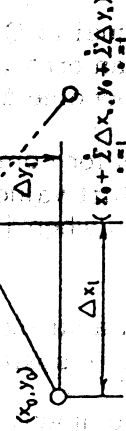

D ****, $\boxed{\text{CR}}$ is equal to D ****, 0 $\boxed{\text{CR}}$.

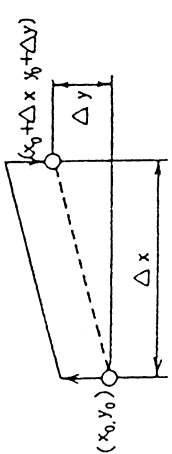
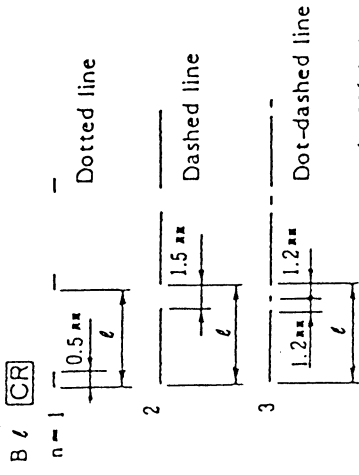
D, **** $\boxed{\text{CR}}$ is equal to D0, **** $\boxed{\text{CR}}$.

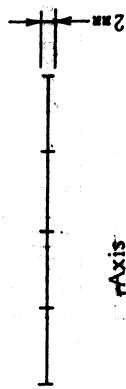
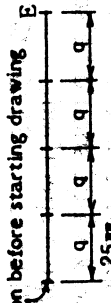
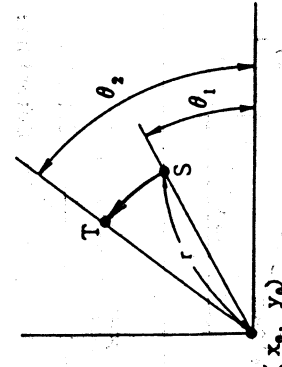
D **** $\boxed{\text{CR}}$ is equal to D ****, 0 $\boxed{\text{CR}}$. And J $\boxed{\text{CR}}$ is equal to J0 $\boxed{\text{CR}}$ (same in case of commands Q and L too).

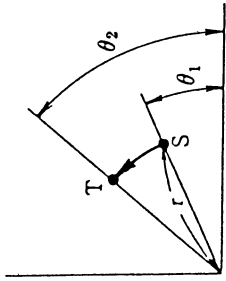
Allowable area is limited for parameters to key in for each command. Refer to the function and input format, for the area, in Table 7-1, Drawing commands.

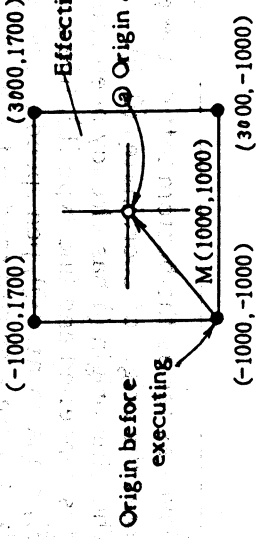
Table 7-1 Drawing Commands

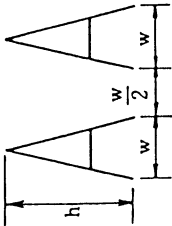
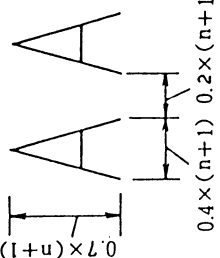
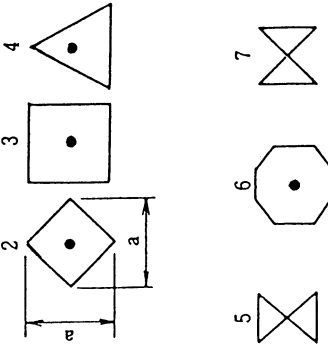
Command	Command Name	Input Format	Function and Input Condition
D	DRAW ABSOLUTE	<p>D $x_1, y_1, x_2, y_2, \dots, x_n, y_n$ CR</p>  <p style="text-align: center;">(x_0, y_0) (x_1, y_1) (x_n, y_n)</p> <p style="text-align: center;">(x_0, y_0) : Present pen position</p>	<p>Connects from the present pen position (x_0, y_0) to coordinate positions $(x_1, y_1) \dots (x_n, y_n)$ in order with a straight line. Coordinate values must be from -9999 to 9999 and expressed by an integer times the 0.1 mm. (Ex.) Coordinate values (100, 100) are; $x = 100 \text{ mm}, y = 100 \text{ mm}$. Note, however, that an input error occurs if the commands CR and comma(,) are written with more than 132 character.</p>
I	DRAW RELATIVE	<p>I $\Delta x_1, \Delta y_1, \Delta x_2, \Delta y_2, \dots, \Delta x_n, \Delta y_n$ CR</p>  <p style="text-align: center;">(x_0, y_0) $(x_0 + \Delta x_1, y_0 + \Delta y_1)$ (x_n, y_n)</p>	<p>Draws a group of straight lines from the present pen position to shift amounts of $(\Delta x_1, \Delta y_1), (\Delta x_2, \Delta y_2) \dots (\Delta x_n, \Delta y_n)$. Shift amounts must be from -9999 to 9999 and expressed by an integer times the 0.1 mm. Note, however, that an input error occurs if the commands CR and comma(,) are written with more than 132 characters.</p>
M	MOVE ABSOLUTE	<p>M x, y CR</p>  <p style="text-align: center;">(x_0, y_0) (x, y) (x_n, y_n)</p>	<p>Shifts from the present pen position (x_0, y_0) to coordinate point (x, y) with the pen up. Pen does not lower even after the shift. Input condition is just the same as command D. If specifying multi-parameters such as $x_1, y_1, x_2, y_2 \dots x_n, y_n$, pen moves the same as command D with the pen up.</p>

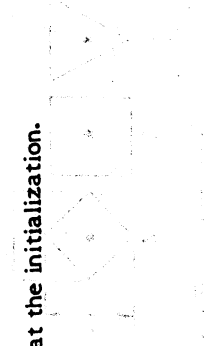
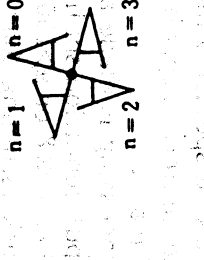

Command	Command Name	Input Format	Function and Input Condition
R	MOVE RELATIVE	$R \Delta x, \Delta y$ CR 	<p>Shifts from the present pen position (x_0, y_0) by shift amount ($\Delta x, \Delta y$) with the pen up. Pen does not lower even after the shift.</p> <p>Input condition is just the same as command I.</p> <p>If specifying multi-parameters such as $\Delta x_1, \Delta y_1, \Delta x_2, \Delta y_2$ $\Delta x_n, \Delta y_n$, pen moves the same as command I with the pen up.</p>
L	LINE TYPE	$L n$ CR ($0 \leq n \leq 3$) $n = 0$ ——— Solid line 1 Dotted line 2 --- Dashed line 3 - - - - - Dot-dashed line <p>At the initialization (power turn-on): $n = 0$</p>	<p>Specifies a line type for drawing a straight line, circle or arc. Condition shall be set as $0 \leq n \leq 3$ and processing is made on the assumption of $n = 0$ when n value is outside this range. Once specified, it is retained until re-specified. The length of repetitive line should be specified in LINE SCALE command B when n value is any of 1, 2 and 3.</p>
B	LINE SCALE	$B l$ CR  <p>At the initialization : $l = 100(10mm)$</p>	<p>Specifies the repetitive length of dotted line, dashed line or dot-dashed line.</p> <p>When n is specified as 1, 2 or 3 by the LINE TYPE command L, then the l value should be specified in coordinates for the line type n specified.</p> <p>The l shall be set as $25 \leq l \leq 2000$ and if $l < 25$ or $l > 2000$ is specified, processing is made assuming that $l = 25$ or $l = 2000$ has been specified, respectively.</p> <p>Once specified, it is retained until re-specified.</p>

Command	Command Name	Input Format	Function and Input Condition												
X	AXIS	<p>$X \ p, q, r \ \boxed{CR}$</p>  <table border="1" data-bbox="368 1056 572 1444"> <thead> <tr> <th>Type</th> <th>P</th> <th>q</th> <th>r</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>X 0</td> <td>Unit length</td> <td>Number of repetitions</td> </tr> <tr> <td>2</td> <td>Y 1</td> <td>Total length</td> <td>Number of divisions</td> </tr> </tbody> </table> <p>(q shall be specified by length)</p>	Type	P	q	r	1	X 0	Unit length	Number of repetitions	2	Y 1	Total length	Number of divisions	<p>Draws a coordinate axis in either positive or negative direction in parallel with X or Y axis from the present pen position. An input error will occur unless the conditions given below are satisfied.</p> <p>With Type 1; $r > 0.1 \leq q \times r \leq 9999$</p> <p>With Type 2; $r > 0.1 \leq q \leq 9999, q \geq r \quad 0 \leq p \leq 3$</p> <p>(Ex.) In case $p = 0, q = 250, r = 4$</p>  <p>After drawing an axis, pen is raised at point E. This is just the same as the case of $p = 2, q = 1000$ and $r = 4$.</p>
Type	P	q	r												
1	X 0	Unit length	Number of repetitions												
2	Y 1	Total length	Number of divisions												
C	CIRCLE ABSOLUTE	<p>$C \ x_0, y_0, r, \theta_1, \theta_2 \ \boxed{CR}$</p>  <p>(x_0, y_0) : Coordinate value of center θ_1 : Degree of start point(S) θ_2 : Degree of terminal point(T) r : Radius</p>	<p>Moves to S point and draws a circle or arc.</p> <p>Input condition shall be $0 < r \leq 8000, 0 \leq \theta_1, \theta_2 \leq 360^\circ$.</p> <p>An input error will occur unless conditions given above are satisfied.</p> <p>Drawing is made counterclockwise and pen rises and stops when the drawing has been finished. (Solid line between S and T). Line type can be selected by command L.</p> <p>In drawing a circle, θ_1 and θ_2 can be omitted.</p> <p>(Ex.) Key in C 1000, 1000, 500 \boxed{CR} when drawing a circle of $x_0 = 100$ mm, $y_0 = 100$ mm and $r = 50$ mm.</p>												

Command	Command Name	Input Format	Function and Input Condition
E	CIRCLE RELATIVE	<p data-bbox="294 1246 326 1448">E r, θ_1, θ_2 [CR]</p>  <p data-bbox="677 1103 702 1422">θ_1 : Degree of start point(S)</p> <p data-bbox="711 1069 736 1422">θ_2 : Degree of terminal point(T)</p> <p data-bbox="746 1297 771 1422">r : Radius</p>	<p data-bbox="294 155 351 940">Draws a circle or arc with the present pen position as a center.</p> <p data-bbox="357 112 426 940">Input condition shall be $0 < r \leq 8000$, $0 \leq \theta_1$, $\theta_2 \leq 360^\circ$. An input error will occur unless conditions are inside the ranges.</p> <p data-bbox="432 112 520 940">Drawing is made counterclockwise and pen rises and stops when the drawing has been finished. (Solid line between S and T) Line type can be selected by command L.</p> <p data-bbox="526 112 583 940">In drawing a circle, θ_1 and θ_2 can be ignored.</p> <p data-bbox="589 90 614 940">(Ex.) Key in E 500 [CR] when drawing a circle of $r = 50$ mm.</p>
H	HOME	H [CR]	<p data-bbox="906 133 975 940">Moves as far as the bottom left of the effective drawing area, the origin of coordinates (0, 0).</p> <p data-bbox="981 112 1107 940">When the origin @ has already been specified, command @ is cancelled and line type (L), line scale (B), alpha scale (S), alpha rotate (Q), pen speed (T), window (W) and paper size (F) are also returned to the initial setting.</p>

Command	Command Name	Input Format	Function and Input Condition
@	SET ORIGIN	@ CR	<p>Sets the present pen position as a drawing origin. Origin is set at the bottom left of drawing area after power is turned ON. This is a position for H CR or M0, 0 CR. Pen must be within the drawing area, and if not, an error will occur.</p> <p>(Ex.) In case of M 1000, 1000 CR and @ CR, a drawing area is to be set as shown below.</p> 
J	PEN SELECTION	J x CR (0 ≤ x ≤ 6)	<p>Selects a specified number of pen from the stocker. Pens are numbered 1 to 6 from the front (See Fig. 4-2). Input condition shall be 0 ≤ x ≤ 6 and if x is out of this range, the plotter assumes that x = 1 has been specified. When x = 0, the pen carriage puts the pen back to the original position and does not move to pick up a new pen. (Note) Do not provide the pen carriage with a pen before the power is turned ON.</p>
P	PRINT	P C ₁ C ₂ ... C _n CR (C ₁ ~C _n : ASCII code)	<p>Prints characters from the present pen position in the form of ASCII codes specified by C₁ to C_n with 131 characters excluding CR. No print is made for parts exceeding the effective drawing area. Print is done in the direction of character rotating command Q if it has been specified. Character space and size are specified by command S.</p>

Command	Command Name	Input Format	Function and Input Condition
S	ALPHA SCALE	<p> S h, w \boxed{CR}  h: Height w: Width At the initialization: $h = 30$, $w = 18$ </p>	<p>Specifies the height and width of a character.</p> <p>Input condition (1) $25 \leq h \leq 2000$ When $h < 25$ or $h > 2000$ is specified, then the plotter assumes that $h = 25$ (2.5 mm) or $h = 2000$ (200 mm) has been specified, respectively. (2) $10 \leq w \leq 2000$ When $w < 10$ or $w > 2000$ is specified, then the plotter assumes that $w = 10$ (1 mm) or $w = 2000$ (200 mm) has been specified, respectively.</p>
		<p> S n \boxed{CR} ($3 \leq n \leq 15$)  $0.7 \times (n+1)$ $0.4 \times (n+1)$ $0.2 \times (n+1)$ </p>	<p>Specifies the character size.</p> <p>The character height, width and spacing are constant.</p> <p>The standard is $\pi+1$ time the 0.7 mm (height), 0.4 mm (width) and 0.2 mm (spacing).</p> <p>(Ex.) When $n = 9$ $0.7 \times 10 = 7$ mm height $0.4 \times 10 = 4$ mm width $0.2 \times 10 = 2$ mm spacing</p> <p>However when $n \leq 2$, the character size is 3 mm high, 1.8 mm wide and 0.9 mm spacing, the same as S 30, 18 \boxed{CR}. With $n > 15$, processing is made assuming that $n = 15$.</p>
N	MARK	<p> N n, a \boxed{CR} ($1 \leq n \leq 7$) $r = 1$  At the initialization : $n = 1$ $a = 18$ </p>	<p>Draws a specified mark with the present pen position as the center. n specifies kind of mark while a specifies size of mark.</p> <p>Processing is made assuming that $n = 1$ except when $1 \leq n \leq 7$. Input condition shall be $18 \leq a \leq 100$.</p> <p>When $a < 18$ or $a > 100$ is specified, then the plotter draws a mark assuming that $a = 18$ (1.8 mm) or 100 (10 mm), respectively.</p> <p>No error will occur when keying in Nn \boxed{CR} and the processing is made assuming that $a = 18$. (Ex.) $N2$ \boxed{CR} is the same as $N2$, 18 \boxed{CR}.</p>

Command	Command Name	Input Format	Function and Input Condition
Q	ALPHA ROTATE	<p>$Q \ n \ \boxed{CR}$ ($0 \leq n \leq 3$)</p> <p>Q = 0° when n = 0, Q = 90° when n = 1, Q = 180° when n = 2, Q = 270° when n = 3.</p> <p>n = 0 at the initialization.</p> 	<p>Rotates characters in the specified direction. Input condition shall be $0 \leq n \leq 3$ and when n value is specified outside this range, the plotter assumes that n = 0 has been specified. (Ex.)</p> 
Z	PAPER CHANGE POSITION	<p>$Z \ \boxed{CR}$</p>	<p>The pen carriage goes to put the presently held pen in the pen stocker and shifts to the top center. Value at the initialization is respectively set for line type (L), line scale (B), alpha scale (S), alpha rotate (Q), pen speed (T), window (W), paper size (F) and set origin (O). It is convenient to use this command for replacing charts.</p>
T	PEN SPEED	<p>$T \ n \ \boxed{CR}$ ($n = 0 \text{ or } 1$)</p> <p>n=0 Pen speed: Max. 100 mm/s in axial direction n=1 Pen speed: Max. 200 mm/s in axial direction</p> <p>At the initialization: n = 1</p> 	<p>Specifies the pen speed, normal or slow speed. Input condition shall be either n = 0 or 1. When a figure other than this is keyed in, the plotter assumes that n = 1 has been specified.</p>

Command	Command Name	Input Format	Function and Input Condition
F	PAPER SIZE	<p>F n CR ($0 \leq n \leq 2$)</p> <p>n = 0 A4 size (190(W) x 250(D) mm)</p> <p>n = 1 Legal size (355(W) x 190(D) mm)</p> <p>n = 2 A3 size (400(W) x 270(D) mm)</p> <p>At the initialization: n = 2</p>	<p>Limits the effective drawing area in line with the chart and moves to the bottom left of the effective drawing area. Input condition shall be $0 \leq n \leq 2$ and when n is specified outside this range, the plotter assumes that n = 2 has been specified.</p> <p>When the effective drawing area is altered by command W, this command is ignored even if keyed in.</p>
W	WINDOW	<p>W x_1, y_1, x_2, y_2 CR</p> <div data-bbox="729 1088 995 1412" style="text-align: center;"> </div> <p>At the initialization: $x_1, y_1 = (0, 0)$ $x_2, y_2 = (4000, 2700)$</p>	<p>Specifies the effective drawing area and moves to the bottom left of the effective drawing area, that is, to a coordinate (x1, y1). Parameters x1, x2, y1 and y2 are limited as follows as input conditions.</p> <p>$0 \leq x_1 < 4000, 0 \leq y_1 \leq 2700$ $0 < x_2 \leq 4000, 0 < y_2 \leq 2700$ and $x_1 < x_2, y_1 < y_2$</p> <p>An error will occur unless parameters satisfy range shown above.</p>

7.2 Automatic Pen-up Function

The pen automatically rises if the next command is not keyed in when approx. 2 seconds has passed with pen down after the drawing, whereby ink stain can be prevented.

8. ERROR ACTION

8.1 Error Caused by Input Mistake

An error lamp is provided on the control panel of this plotter. It goes on when the input is mistaken, and the plotter does not begin working until the mistake is cancelled.

(1) Causes of error

- o When 5 or more digits of parameters are keyed in

(Ex.) D12345, 200

- o When characters not used for commands are keyed in.

(Ex.) A, C,O, Y etc.

- o When parameters other than those specified are keyed in as input conditions per command.

(Ex.) o With commands C and E, when radius r or angles θ_1 and θ_2 do not satisfy the following ranges.

$$r \leq 0, 0 \leq \theta_1, \theta_2 \leq 360^\circ$$

- o With command X, total axis length (with type 1: $q \times r$, with type 2: q) is not within the range of -9999 to 9999.

Input condition is out of the following range.

$$0 \leq p \leq 3$$

- o With commands D, I, M and R, when the commands, parameters and CR are written with more than 132 characters.
- o With command @, when the pen position is out of the effective drawing area, off scale.
- o Neither CR nor LF is keyed in as a terminator.

(2) Error cancel

Depress any one of four position switches. The error lamp goes off and the plotter is put in a state of "Command wait". When the error is cancelled, all data keyed in to a data buffer are cleared. It is just the same as cancel of an error caused by pen off-scale.

8.2 Error Caused by Off-scale of Pen

Fig. 8-1 shows the effective drawing area (area possible to draw in) and effective parameter area (area in which MPU can calculate). The error lamp goes on, when the drawing is under way, as a coordinate value of the next shifting purpose exceeds (for instance, point B in Fig. 8-1) the effective drawing area (4000, 2700). In addition, the lamp flashes showing that an error has occurred due to input mistake and the drawing stops when a coordinate value of the next shifting purpose exceeds (for instance, point C in Fig. 8-1) the effective parameter area ((-16384, -16384) to (16383, 16383)).

The plotter keeps on drawing when a coordinate value is inside the effective parameter area even if the error lamp goes on. The pen, however, does not move outside the effective drawing area, and the plotter waits for the next command with the pen up, and resumes the drawing as the next command is keyed in. Taking Fig. 8-2 for instance, the plotter draws a straight line from the present pen position (1000, 1000) to a (4000, 1000) point when it has received a "D5000, 1000" command, and the pen rises. Next, when the plotter has received a "D1000, 2000" command, it draws a straight line which connects two points, (5000, 1000) and (1000, 2000), inside the effective drawing area.

With command @ that sets the drawing origin, the coordinate value varies by the shifted amount. Note, however, that the effective drawing area and effective parameter area do not shift versus the original position (same as H[CR]) at the time of power turn-on. Fig. 8-3 shows examples of the effective drawing area and effective parameter area after the command @ has been keyed in.

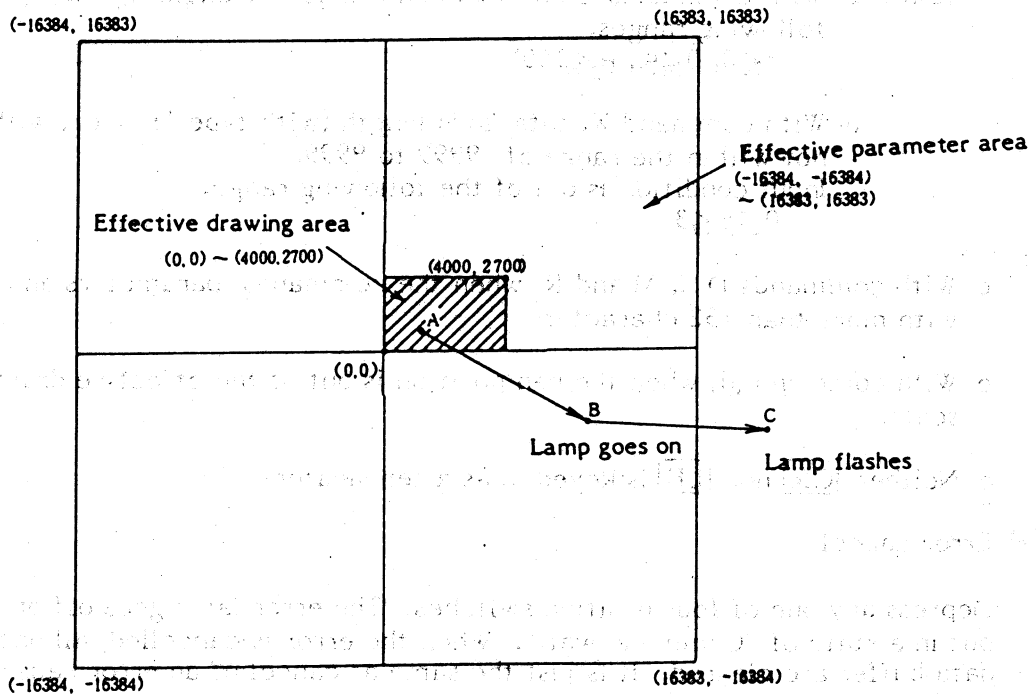


Fig. 8-1 Effective Drawing Area and Effective Parameter Area (Unit: 0.1 mm)

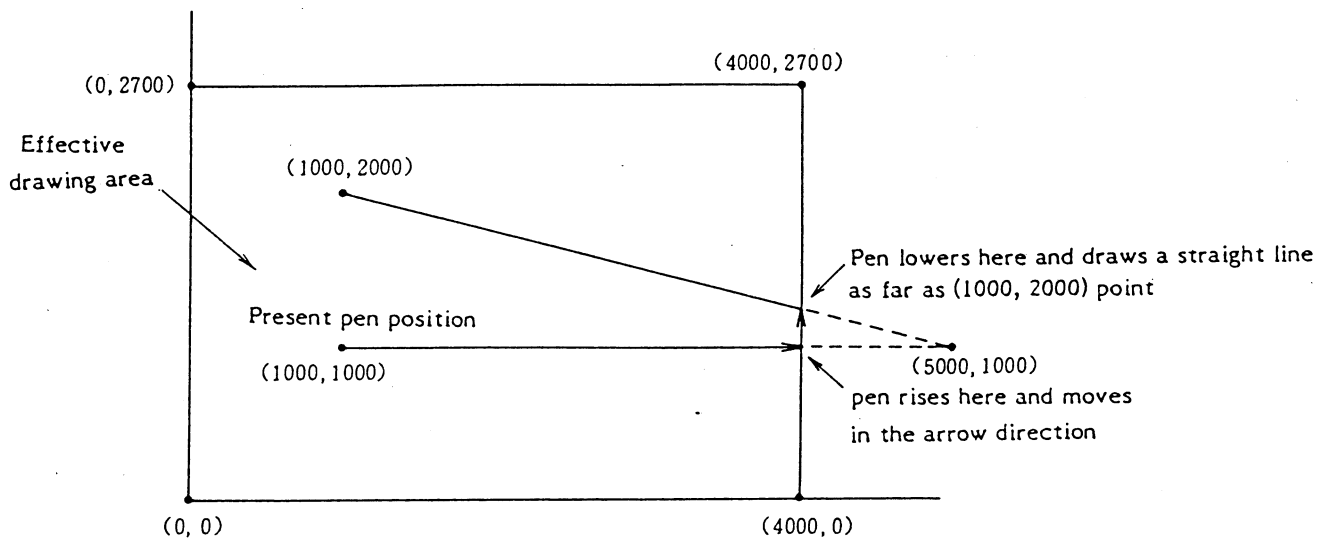


Fig. 8-2 Drawing Based on Off-scale

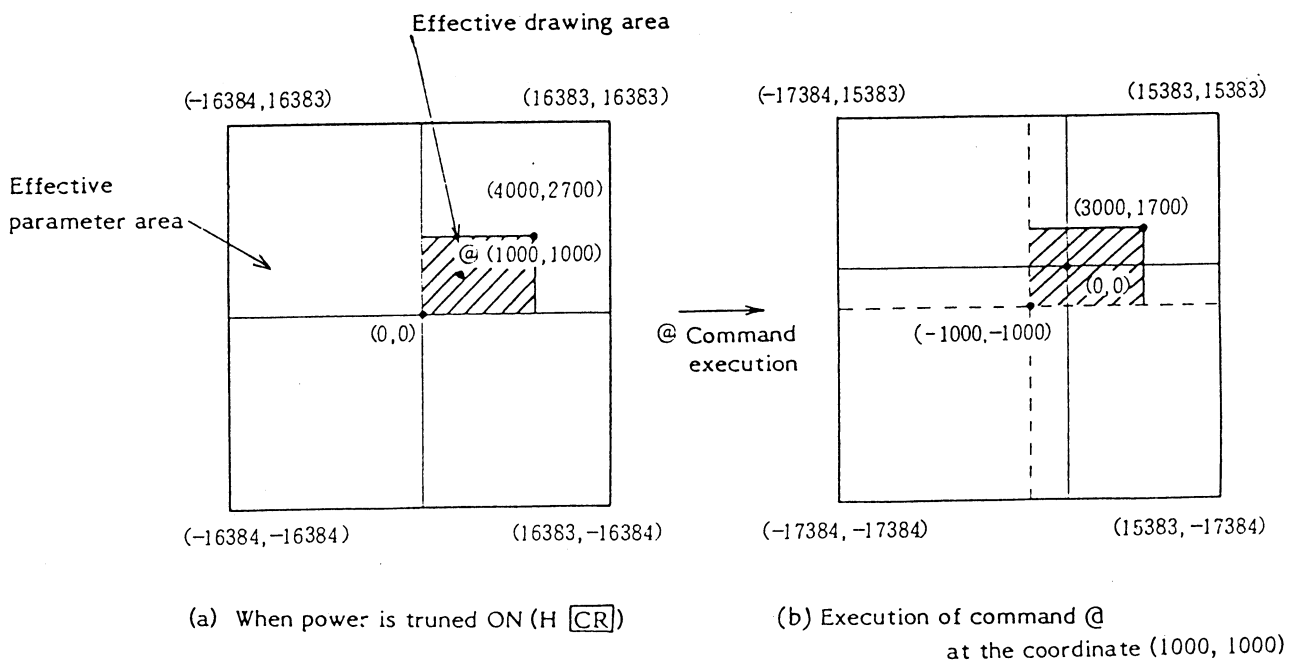


Fig. 8-3 Effective Drawing Area and Effective Parameter Area after Command @ Has keyed in

9. SPECIFICATIONS AND STANDARD ACCESSORIES

9.1 Specifications

Model	671-20
Method	Flat-bed type, pulse motor control method
Effective drawing area	400 mm(W) x 270 mm(H) (A3 size chart)
Chart	Standard paper and OHP film of A3 or smaller size
Chart fixing	Chart holder (magnetic type)
Kind of pen	Aqueous fiber-tip pen of exclusive use Oily fiber-tip pen and aqueous plastic pen are also usable, which are provided at request.
Number & colors of pens	6 pcs. (6 colors: Black, red, blue, green, purple and orange)
Drawing speed	200 mm/s max. in axial direction
Step size	0.1 mm (0.05 mm for internal processing)
Distance accuracy	± 0.2 % of shift distance ± 0.2 mm
Repetition accuracy	0.3 mm
Accuracy of pen exchange	0.4 mm
Control switches	POWER (power supply), Pen UP/DOWN, Position (pen moving)
Indicator	POWER (goes on when power switch is turned ON) ERROR (flashes in event of command error and lights steadily in event of off-scale)
Drawing command	20 kinds
Drawing mode	Self-test mode, Print mode
Interface	8 bits parallel, RS-232-C
Ambient conditions	Temperature: 5 to 40° C Humidity : 45 to 85 % RH
Power supply	200 ~ 240 V AC (187 to 264 V), 50/60 Hz
Power consumption	80 VA
External dimensions	580 mm(W) x 463 mm(D) x 140 mm(H)
Weight	Approx. 11.9 kg

9.2 Standard Accessories

- o Aqueous fiber-tip pen (671-7602) 6 pcs. (Black, red, blue, green, purple and orange)
- o Chart (671-7502) or equivalent 20 sheets (A3 size)
- o Chart holder (671-7702) 2 pcs.
- o Instruction Manual 1 copy
- o Dust Cover 1 pcs.

10. PARTS PROVIDED AT REQUEST

Item	Code
Aqueous fiber-tip pen 6 pieces (Black, red, blue, green, purple, orange)	671-7602
Aqueous fiber-tip pen 6 pieces (Black)	671-7621
Aqueous plastic pen 6 pieces (Black, red, blue, green, purple, orange)	671-7601
Aqueous plastic pen 6 pieces (Black)	671-7611
Oily fiber-tip pen(*1) 6 pieces (Black, red, blue, green, purple, orange)	671-7603
Pen holder for ceramic pen 1 pc. (*2)	671-7651
Standard chart (A4 size Quality paper) 100 sheets	671-7501
Standard chart (A3 size Quality paper) 100 sheets	671-7502
Connection cable (8 bits parallel)	
Connection cable (RS-232-C)	
Chart holder (magnetic rubber type) One pair	671-7702

(*1): It is recommended that the polyester film be used to obtain high quality when the OHP film is used. (However, avoid electrication preventive processed films.)

(*2): This holder made for use with Pentel Co.'s CERAMICRON cartridge.

11. APPLICATION EXAMPLES

Table 11-1 and Fig. 11-1, Table 11-2 and Fig. 11-2 show examples of simple drawing program and drawing using drawing commands.

Table 11-1 Example of Drawing Programs Using Drawing Commands (Bar graph)

```

1  ON ERROR GOTO 6500
100 OPEN"O",#1,"LPT1:"(Note) ..... Initial setting
110 '***** TITLE
120 PRINT#1,"M350,2000" ..... Pen shift
130 PRINT#1,"Q0" ..... Specification of character direction
140 PRINT#1,"S60,35" ..... Specification of character size
150 PRINT#1,"J3" ..... Selection of No. 3 pen
160 PRINT#1,"P**** MODEL 611-20 *****" ..... Printing
170 'GRAPH
180 PRINT#1,"M700,1000" ..... Pen shift
190 PRINT#1,"J1" ..... Selection of No. 1 pen
200 PRINT#1,"I530,0" ..... Horizontal axis drawing
210 PRINT#1,"S30,15" ..... Specification of character size
220 PRINT#1,"M750,950"
230 PRINT#1,"P'78"
240 PRINT#1,"M870,950"
250 PRINT#1,"P'79"
260 PRINT#1,"M990,950"
270 PRINT#1,"P'80"
280 PRINT#1,"M1110,950"
290 PRINT#1,"P'81"
300 PRINT#1,"M700,1000" ..... Pen shift
310 PRINT#1,"X1,150,5" ..... Vertical axis drawing
320 PRINT#1,"M620,980"
330 PRINT#1,"P 0"
340 PRINT#1,"M620,1130"
350 PRINT#1,"P10"
360 PRINT#1,"M620,1280"
370 PRINT#1,"P20"
380 PRINT#1,"M620,1430"
390 PRINT#1,"P30"
400 PRINT#1,"M620,1580"
410 PRINT#1,"P40"
420 PRINT#1,"M620,1730"
430 PRINT#1,"P50"
440 PRINT#1,"M700,1000" ..... Pen shift
450 PRINT#1,"J2" ..... Selection of No. 2 pen
460 PRINT#1,"R50,0"
470 PRINT#1,"I0,225,70,0,0,-225"
480 PRINT#1,"R50,0"
490 PRINT#1,"I0,360,70,0,0,-360"
500 PRINT#1,"R50,0"
510 PRINT#1,"I0,570,70,0,0,-570"
520 PRINT#1,"R50,0"
530 PRINT#1,"I0,510,70,0,0,-510"
540 PRINT#1,"J0" ..... Putting back the pen into the pen stocker
550 PRINT#1,"H" ..... Shift of pen carriage to the origin
560 END
6500 IF ERR=24 THEN RESUME
6510 IF ERR=68 THEN RESUME
6520 ON ERR GOTO 0

```

(Note) These are examples in case of LPT1 port.

MODEL 671-20

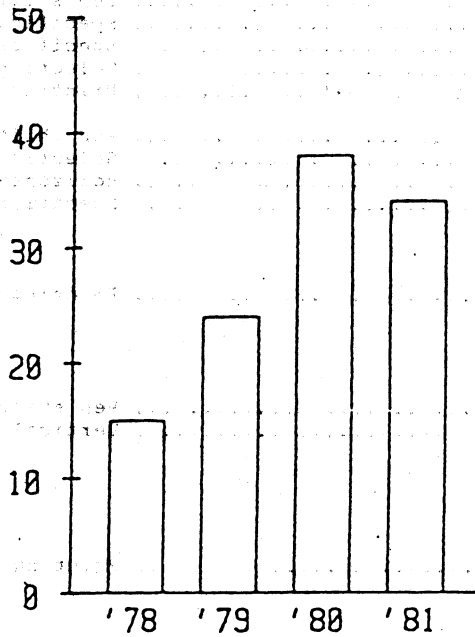


Fig. 11-1 Drawing Made by Table 11-1 Programs

Table 11-2 Example of Drawing Programs Using Sub-routines
(Bar graph, circular graph)

1	ON ERROR GOTO 6500	(Note)	
100	OPEN"0",#1,"LPT1:"	Initial setting	Title drawing
110	'***** TITLE		
120	X=350:Y=1200:GOSUB10320	Pen shift	
130	GOSUB10600:H=60:W=35:GOSUB10700	Spec. of char. direc. & size	
140	GOSUB11130	Select. of specified No. pen	
150	X\$="*** MODEL 671-20 ***":GOSUB10800	Character drawing	
160	'***** BAR-GRAPH		
170	XX=300:YY=200:NX=4:NY=5	} Pen shift	
180	X=XX:Y=YY:GOSUB10320		
190	GOSUB11110	Select. of specified No. pen		Bar graph drawing
200	X=120*NX+50:Y=0:GOSUB10310	Hori. axis drawing	
210	H=30:W=15:GOSUB10700	Spec. of character size	
220	RESTORE 420		
230	FOR I=1 TO NX	} Printing of horizontal axis figures	
240	X=XX+120*I-70:Y=YY-50:GOSUB10320		
250	READ X\$:GOSUB10800		
260	NEXT I		
270	X=XX:Y=YY:GOSUB10320	Pen shift	
280	P=1:Q=150:R=NY:GOSUB10500	Vertical axis drawing	
290	FOR I=0 TO NY	} Printing of vertical axis figures	
300	X=XX-80:Y=YY+150*I-20:GOSUB10320		
310	READ X\$:GOSUB10800		
320	NEXT I		
330	X=XX:Y=YY:GOSUB10320	Pen shift	Circular graph drawing
340	GOSUB11120	Select. of specified No. pen	
350	FOR I=1 TO NX		
360	READ YD	} Bar graph drawing	
370	X=50:Y=0:GOSUB10330		
380	X=0:Y=YD*15:GOSUB10310		
390	X=70:Y=0:GOSUB10310		
400	X=0:Y=-YD*15:GOSUB10310		
410	NEXT I		
420	DATA "78","79","80","81"	} Data of figure and graph	
430	DATA "0","10","20","30","40","50"		
440	DATA 15,24,38,34		
450	'***** PIE-CHART		
460	XX=1200:YY=500:N=5:RR=300:SUM=0:RAD=0:RAD1=0	Initial setting	
470	DIM DAT(10),DAT\$(10):RESTORE 700		
480	GOSUB11140	Select. of specified No. pen	
490	FOR I=1 TO N	} Position calculation of character in the circular graph	
500	READ DAT(I):SUM=SUM+DAT(I)		
510	READ DAT\$(I)		
520	NEXT I		
530	X0=XX:Y0=YY:R=RR:C1=0:C2=360:GOSUB11000	Circle drawing	
540	X=XX:Y=YY:GOSUB10320	Pen shift	
550	FOR I=1 TO N	} Drawing of circular graph border line and character	
560	RAD=RAD+3.14*2*DAT(I)/SUM		
570	X=RR*SIN(RAD):Y=RR*COS(RAD):GOSUB10310		
580	X=XX:Y=YY:GOSUB10320		
590	RAD1=RAD-3.14*DAT(I)/SUM		
600	X=RR/2*SIN(RAD1)-10:Y=RR/2*COS(RAD1):GOSUB10330		
610	X\$=DAT\$(I):GOSUB10800		
620	X=XX:Y=YY:GOSUB10320		
630	NEXT I		
640	X=XX+RR+50:Y=YY+RR-50:GOSUB10320	Pen shift	

(cont'd)

```
650 GOSUB11150
660 FOR I=1 TO N
670 X$=DAT$(I)+" "+STR$(DAT(I))+(" "+STR$(INT ... Drawing of table representing
      (DAT(I)/SUM*100))+"%":GOSUB10800 circular graph values
680 X=XX+RR+50:Y=YY+RR-50-I*100:GOSUB10320
690 NEXT I
700 DATA 93,"A",80,"B",60,"C",36,"D",32,"E" ..... Table data of circular graph
710 GOSUB11100 ..... Putting back the pen into the pen stocker
720 GOSUB10100 ..... Shift of pen carriage to the origin
730 END
6500 IF ERR=24 THEN RESUME
6510 IF ERR=68 THEN RESUME
6520 ON ERROR GOTO 0
10000 ***** SUBROUTINE *****
10100 PRINT#1,"H":RETURN 'HOME
10300 PRINT#1,"D";INT(X);", ";INT(Y):RETURN 'DRAW ABSOLUTE
10310 PRINT#1,"I";INT(X);", ";INT(Y):RETURN 'DRAW RELATIVE
10320 PRINT#1,"M";INT(X);", ";INT(Y):RETURN 'MOVE ABSOLUTE
10330 PRINT#1,"R";INT(X);", ";INT(Y):RETURN 'MOVE RELATIVE
10400 PRINT#1,"L":RETURN 'SOLID LINE
10500 PRINT#1,"X";INT(P);", ";INT(Q);", ";INT(R):RETURN 'AXIS
      'ALPHA ROTATE( 0°)
10600 PRINT#1,"Q":RETURN 'ALPHA SCALE
10700 PRINT#1,"S";INT(H);", ";INT(W):RETURN 'PRINT
10800 PRINT#1,"P";X$:RETURN
11000 PRINT#1,"C";INT(X0);", ";INT(Y0);", ";INT(R);
      ", ";INT(C1);", ";INT(C2):RETURN 'CIRCLE ABSOLUTE
11100 PRINT#1,"J0":RETURN 'PEN SELECT NO 0
11110 PRINT#1,"J1":RETURN 'PEN SELECT NO 1
11120 PRINT#1,"J2":RETURN 'PEN SELECT NO 2
11130 PRINT#1,"J3":RETURN 'PEN SELECT NO 3
11140 PRINT#1,"J4":RETURN 'PEN SELECT NO 4
11150 PRINT#1,"J5":RETURN 'PEN SELECT NO 5
```

Sub-
routine
for
drawing
commands

(Note) These are examples in case of LPT1 port.

MODEL 671-20

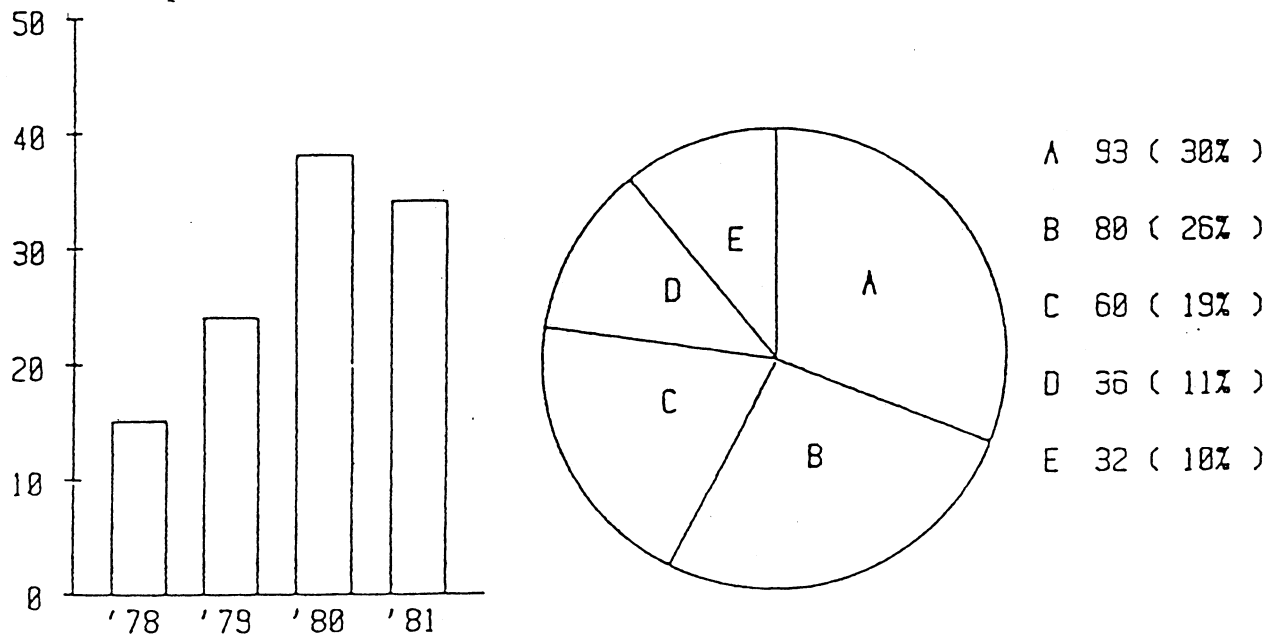


Fig. 11-2 Drawing Made by Table 11-2 Programs

Notes on use of Hitachi BASIC MASTER 16000 Series

(1) When using the 8-bit parallel interface

In case when this plotter is used in combination with the Hitachi BASIC MASTER 16000 Series, the computer may stop automatically and display "Device Timeout" or "Device Unavailable" if the drawing time of the plotter given by only one drawing command exceeds 7 seconds (When making the plotter draw many continuous lines or print out a lot of characters).

To avoid it, be sure to add the following instructions in programming with the use of BASIC.

```
1 ON ERROR GOTO 65000
65000 IF ERR=24 THEN RESUME
65010 IF ERR=68 THEN RESUME
65020 IF ON ERROR GOTO 0
```

Example of program list

```
1 ON ERROR GOTO 65000
10 OPEN "0", #1, "LPT1:"
20 PRINT #1, "J1"
30 PRINT #1, "M450, 1100"
40 PRINT #1, "I1000, 0, 0, 500, -1000, 0, 0, -500"
50 PRINT #1, "R100, 200"
60 PRINT #1, "S8"
70 PRINT #1, "PMB-16000 SERIES"
80 PRINT #1, "Z"
90 END
65000 IF ERR=24 THEN RESUME
65010 IF ERR=68 THEN RESUME
65020 IF ON ERROR GOTO 0
```

(2) When using the RS-232-C interface

In case when this plotter is used in combination with the Hitachi BASIC MASTER 16000 Series through a RS-232-C interface port, the computer may automatically stop and display "Device I/O Error".

To Avoid it, be sure to add the following instruction in programming with the use of BASIC.

```
1 DEF SEG=0 : POKE &H4C8, 0
```

Example of program list

```
1 ON ERROR GOTO 6500
10 OPEN "COM1:1200, N, 8, 2, CS65535" AS #1
20 PRINT #1, "J1"
30 PRINT #1, "M450, 1100"
40 PRINT #1, "I1000, 0, 0, 500, -1000, 0, 0, -500, "
50 PRINT #1, "R100, 200"
60 PRINT #1, "S8"
70 PRINT #1, "P**** ABCDEFGHIJKL ****"
80 PRINT #1, "Z"
90 END
```

Notes on use of this Plotter in connection
with IBM Personal Computer

Be careful, in using this plotter in connection with the IBM Personal Computer, that the computer automatically stops and shows "Device Timeout" or "Device Unavailable" when making the plotter draw an extremely long line or print out a lot of characters etc.

To avoid it, therefore, be sure to add the following program before preparing the program using the BASIC.

(1) In case of using 8 bit parallel interface

```
1 ON ERROR GOTO 6500
65000 IF ERR=24 THEN RESUME
65010 IF ERR=68 THEN RESUME
65020 IF ON ERROR GOTO 0
```

Example of program list

```
1 .ON ERROR GOTO 6500
10 OPEN "0", #1, "LPT1:"
20 PRINT #1, "J1"
30 PRINT #1, "M450, 1100"
40 PRINT #1, "I1000, 0, 0, 500, -1000, 0, 0, -500"
50 PRINT #1, "R100, 200"
60 PRINT #1, "S8"
70 PRINT #1, "PMB-16000 SERIES"
80 PRINT #1, Z"
90 STOP:END
6500 IF ERR=24 THEN RESUME
6510 IF ERR=68 THEN RESUME
6520 IF ERROR GOTO 0
```

(2) In case of using RS-232-C interface

```
1 ON ERROR GOTO 6500
10 OPEN"COM1:1200,N,8,2,CS65535"AS#1
6500 IF ERR=24 THEN RESUME
6510 IF ERR=68 THEN RESUME
6520 IF ERROR GOTO 0
```

Example of program list

```
1 ON ERROR GOTO 6500
10 OPEN "0", #1, "LPT1:"
20 PRINT #1, "J1"
30 PRINT #1, "M450, 1100"
40 PRINT #1, "I1000, 0, 0, 500, -1000, 0, 0, -500, "
50 PRINT #1, "R100, 200"
60 PRINT #1, "S8"
70 PRINT #1, "P*** ABCDEFGHIJKL ***"
80 PRINT #1, Z"
90 STOP:END
6500 IF ERR=24 THEN RESUME
6510 IF ERR=68 THEN RESUME
6520 IF ERROR GOTO 0
```